ENGINEERING AND MINING JOURNAL

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FOUNDED 1866

Author Austin

ROOF SEWING—New technique for ground support invented by E. Tröften and reported by C. C. Austin p. 91

Engineer Tröften

Metallurgist Wendt

NEW PROCESS for treating low-grade oxidized zinc ores:

Smithsonite + $NH_4OH \rightarrow Zn(NH_3)CO_3 + H_2O$

p. 84

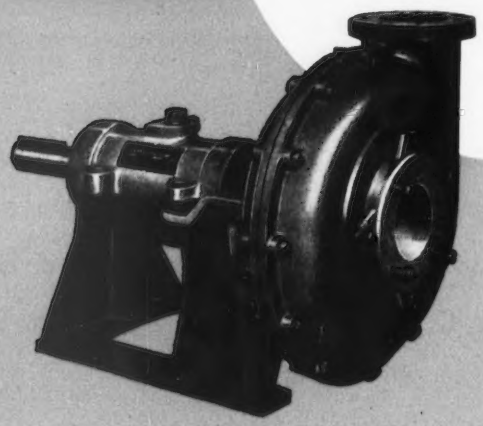
Geologist Steen

URANIUM JACKPOT — Output from new Colorado Plateau mine passes $1-million mark p. 72

Salute to Viola p.126 New "Letters" Department p.4 70-ton Ore Trailer p.113

In pumping abrasives

does the seal-water factor prevent your using Hydroseals ?



CENTRISEAL pump

MAXIMIX RUBBER PROTECTED

This is your answer for efficiency

A worthy companion of the world-famous Hydroseal, the Centriseal Materials Handling Pump is designed to operate entirely without sealing water. If your pulp must be delivered undiluted or if sealing water is hard to get, this is the pump for your process.

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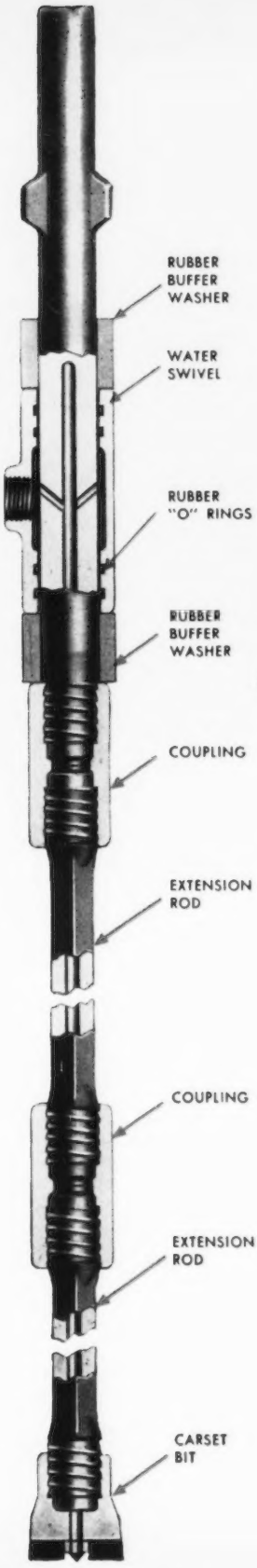
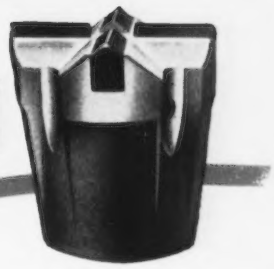


Everything you need for

LONG HOLE DRILLING

WITH

Carset Jackbits



Holes up to 100 feet deep are now being drilled faster and at much lower cost by this I-R Carset method

The longer-lasting, faster-drilling Carset Jackbit, with practically no gauge wear, has revolutionized deep hole drilling with I-R Drifters and coupled steels. The Carset method is not only much faster, but less costly than when using diamond drills. No special training is needed and the work can be done by regular miners with a minimum of supervision.

To permit the most efficient deep hole drilling with I-R Drifters and Carset bits, Ingersoll-Rand has developed and perfected a *complete line* of accessory equipment—including a water swivel that feeds hole cleaning air and water at high pressure directly into the drill steel without going thru the drill—a rugged, long-lasting coupling with the same threads as the bits—and extra-strong alloy steel extension rods.

This combination of equipment, shown at the left, has proved remarkably successful in a host of deep-hole drilling applications. Ask your nearest I-R representative for the complete story. He can supply *everything you need*—from the bit all the way back to the compressor.

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COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS
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ENGINEERING AND MINING JOURNAL

87th YEAR OF PUBLICATION
VOLUME 154 NUMBER 9

A McGRAW-HILL PUBLICATION

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SEPTEMBER, 1953

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LETTERS TO THE EDITOR

Let's have your comments too! Your reactions to articles and features appearing in *E&MJ* will be welcomed. Address your letters to The Editor, Engineering and Mining Journal, 330 West 42nd Street, New York 36, N. Y.

Plaudits for July

Sir:

Your July edition of the *Engineering and Mining Journal* should not be taken as just another monthly job. This is an outstanding number and deserves special mention because it is a ready reference book for all of us.

CHARLES A. MITKE
Ventures, Ltd.
New York City

Sir:

It was a very pleasant experience to peruse the July issue of *E&MJ*. Something of this sort has been needed for a long time . . . The articles published in this issue are sufficiently voluminous and detailed to deserve careful study. The summary tabulations of projects under way, costs, and additions to capacity, are particularly helpful. . . .

O. E. KIESSLING
United States Tariff Commission
Washington, D. C.

The Good Old Days

Sir:

I recently got the thrill of my life when a friend of mine who is a mineral engineer brought to me the June copy of *Engineering and Mining Journal* and told me to read an article entitled "Boom at Rhyolite—1905."

Please let's have some more stories

(*Continued on p. 206*)

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER

Grommet belts last 3 times longer in 90 day use-and-abuse test

B. F. Goodrich V belts last longer, yet cost no more

BIG portable crushing plants like this are built to take the jolting, jarring action of rock crushing. But the shock to V belts is terrific. In this case, the belts used to drive the crusher weren't lasting much more than 30 days. A B. F. Goodrich man heard about the frequent replacements, and asked to install a test set of Grommet V belts. Instead of being ready for the junkpile after 30 days, the Grommet belts were still going strong after 90 days of rugged use and abuse.

Strongest V belt made

No wonder B. F. Goodrich Grommet belts outlast and outperform ordinary belts. In Grommet belts, all the load-carrying cords are concentrated in twin grommets. A grommet is like a giant twisted cable except that it's endless. Since there are no center cords, the Grommet belt is more flexible, and so can "give" temporarily and absorb shock loads. And there's no overlapping cord *section* as in all ordinary belts—no weak spots to cause premature belt failure.

⅓ more gripping power

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're free to flex and grip sheaves better. Size for size, Grommet belts give ⅓ more gripping power with less slip, pull heavier loads with a higher safety factor.

Send for proof today

Send the coupon for a set of reports showing actual installations where Grommet V belts have outlasted all others. See how you, too, can make important savings in belting, production and maintenance costs with these stronger, longer-lasting V belts.

Grommet—T. M. The B. F. Goodrich Co.

The B. F. Goodrich Company
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☐ Send set of installation reports on B. F. Goodrich Grommet belts.
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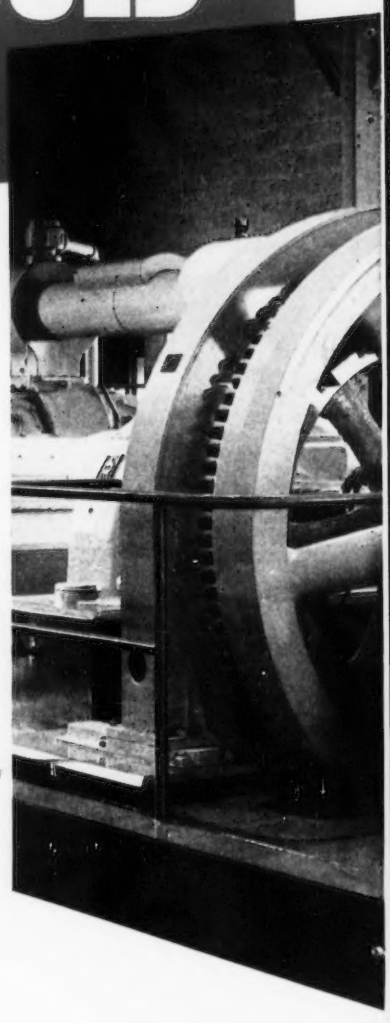
Grommet V-Belts BY
B.F. Goodrich

WHAT EVERY COMPRESSOR OPERATOR SHOULD KNOW...



Years of working with air compressor operators in every field have shown Texaco Lubrication Engineers that clean, low-cost performance comes only when you lubricate your compressors with an oil that's *exactly right* for *your particular* operating conditions.

That is why there is *a complete line* of Texaco air compressor oils — one to assure maximum efficiency and economy whatever the type or size of your compressors, whatever your operating conditions. Let a Texaco Lubrication Engineer help you select the proper one.

For your drills, use *Texaco Rock Drill Lubricant EP.* It's a favorite with drill doctors because its extreme pressure properties give top protection against wear, and it guards against rust whether drills are running or idle. You'll get longer drill life, reduce your maintenance costs.

Find out how Texaco can help you keep all your machines working more efficiently, bring down your costs. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

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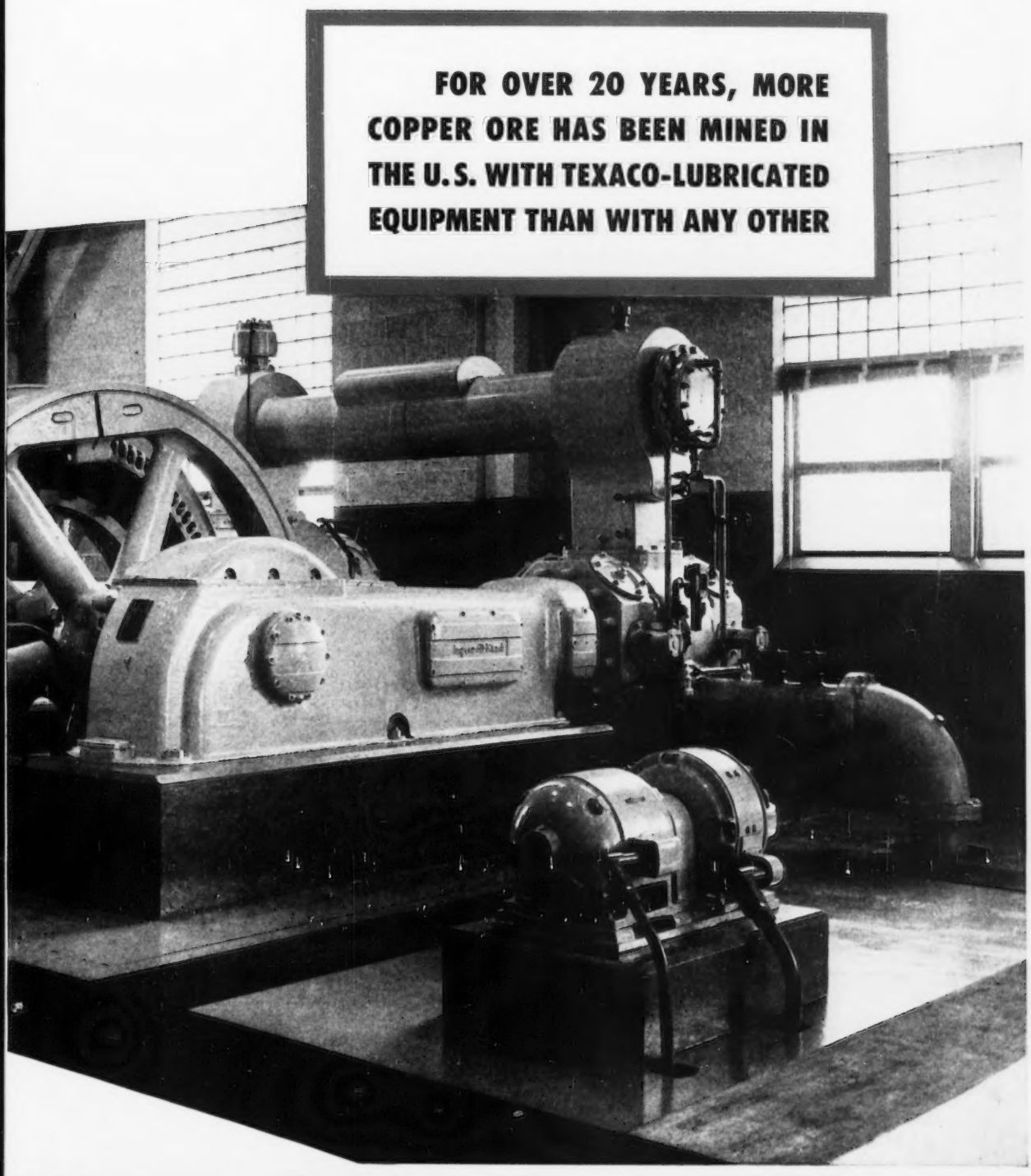
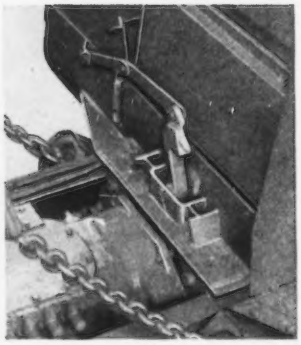


Lubricants and Fuels

FOR THE MINING INDUSTRY

GRAVITY DUMP



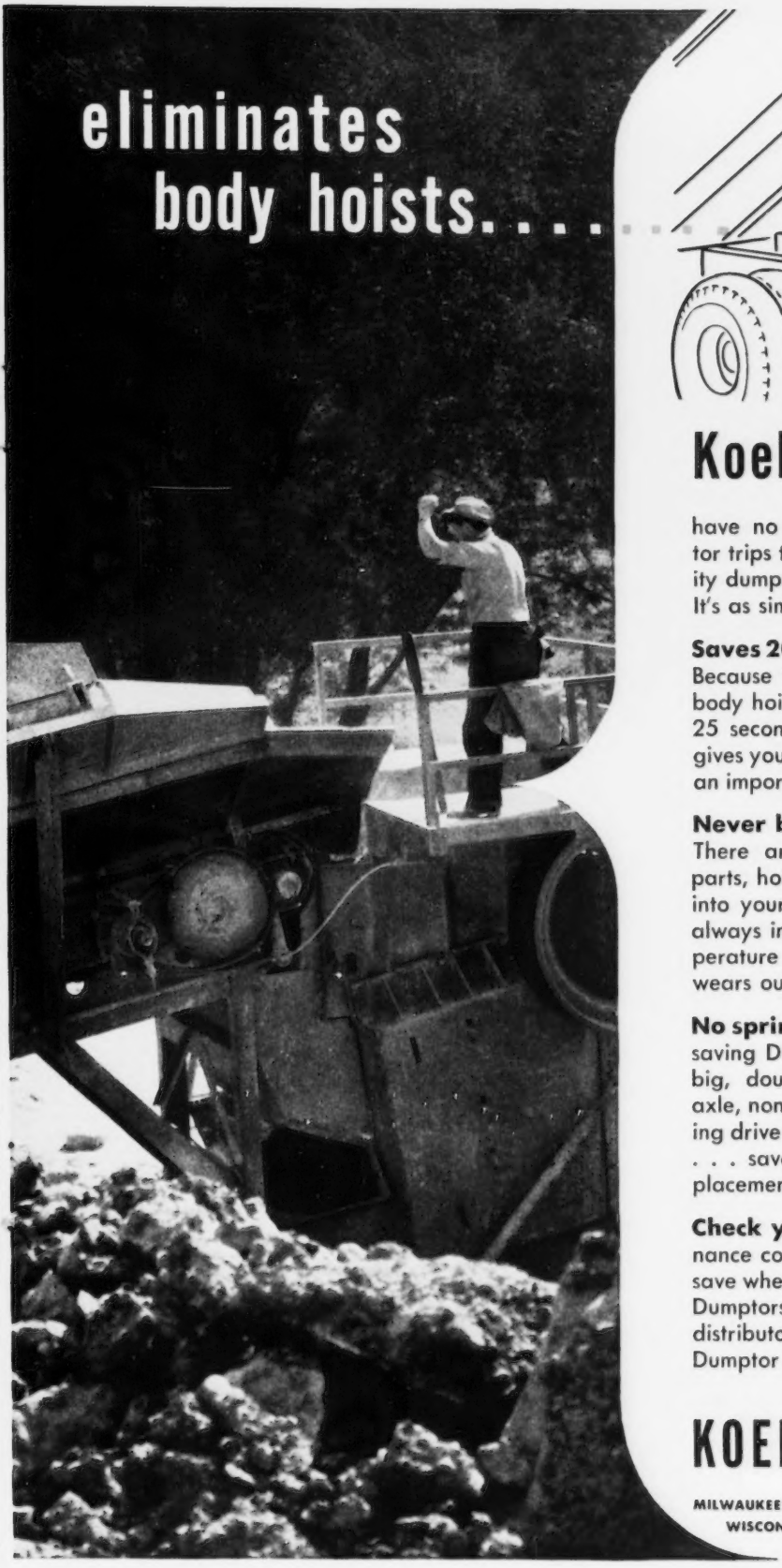
SIMPLE BODY RELEASE LEVER WORKS *INSTANTLY*

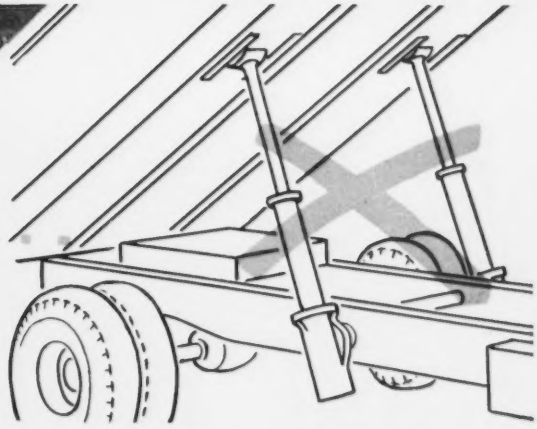
1 Body release lever is located in cab to left of steering wheel. Lever engages toggle linkage to latch hook on chassis . . .

2 Trip rod instantly releases latch hook from body latch seat on the tilting Dumptor body. Gravity dumps load instantly as . . .

3 Body rolls on heavy-duty rockers. Snub chains attached to big coil spring shock absorbers check body at 70-degree tilt.

eliminates body hoists. . . .





Koehring Dumptors®

have no slow-working body hoists. Operator trips the body-release lever . . . and gravity dumps the 6-yard load in just one second. It's as simple as that!

Saves 20 seconds every time you dump Because there is no waiting for slow-raising body hoists, one-second dumping saves 15 to 25 seconds dump-time on every cycle. This gives you more productive haul-time . . . earns an important increase in extra yards per hour.

Never balks . . . never wears out . . . There are no expensive hoist replacement parts, hoist maintenance or down time to eat into your profits. Koehring gravity dump is always instantaneous, trouble-free in all temperature extremes . . . never balks . . . never wears out.

No spring maintenance is another money-saving Dumptor advantage. There's just one big, double-coil chassis spring on steering axle, none on driving axle. Big shock-absorbing drive tires eliminate need for more springs . . . save spring maintenance time and replacement costs.

Check your body hoist and spring maintenance costs for a year. See how much you'll save when you haul with Koehring heavy-duty Dumptors. Get all the facts from your Koehring distributor soon . . . or write us for 28-page Dumptor catalog.

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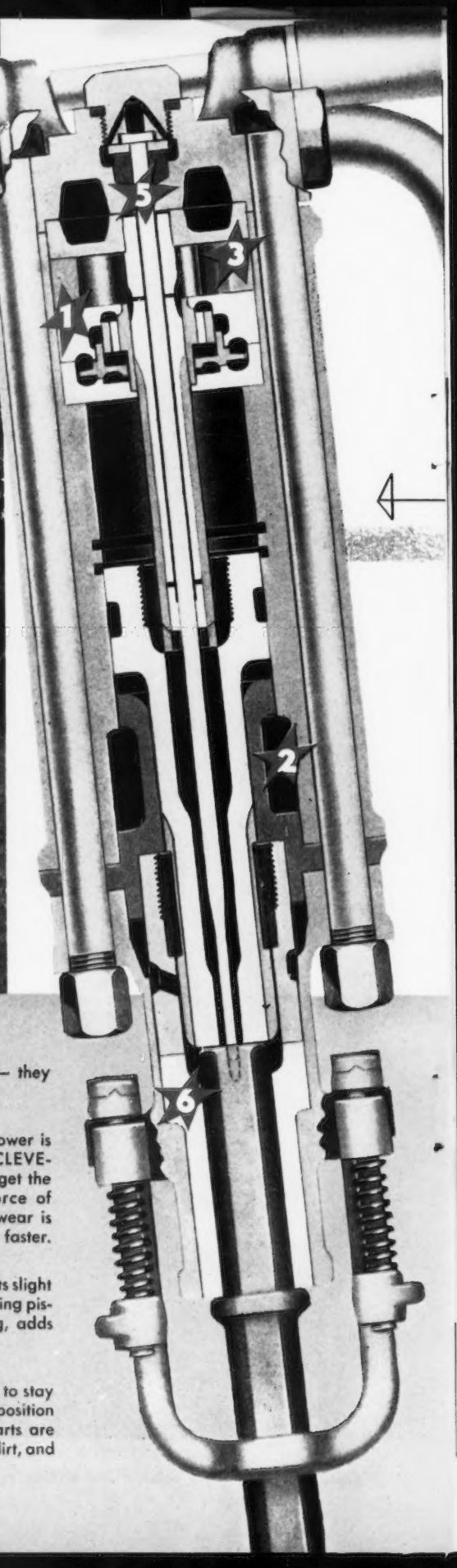


Design Features

1 End-seating valve is fast and positive in action. It meters the air efficiently — keeps air consumption down, provides powerful force of blow and strong rotation. Performance of valve is not affected by wear.

2 Positive lubrication system distributes oil throughout the machine and insures long life for all moving parts. Rifle bar is oiled at every stroke of piston. This prolongs the life of rifle nut and rifle bar at least 50%.

3 All Le Roi-CLEVELAND Sinkers are famous for strong, positive rotation. That's why they are at their best when the drilling's the toughest. Properly designed rotation parts—ratchet, pawls, rifle bar and rifle nut—plus efficient lubrication of these parts, give you this important drilling advantage.

4 Exhaust ports are large — they avoid freezing.

5 Plenty of hole-cleaning power is provided in all Le Roi-CLEVELAND Sinkers, so that you can get the most out of their powerful force of blow and strong rotation. Bit wear is reduced and drilling speeds are faster.

6 Floating-type chuck permits slight misalignment without binding piston. This reduces piston scoring, adds to life of the machine.

7 Throttle valve is designed to stay in any desired operating position from full-on to blowing. All parts are fully enclosed, protected from dirt, and generously lubricated.

Here's the "inside story"

of why Le Roi-CLEVELAND Sinkers drill more footage per shift, stay underground longer

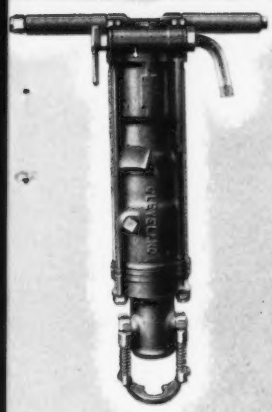
THERE are things you *can't see,* behind Le Roi-CLEVELAND dependability—"hidden values," design details. But you know *they're there*—because that's why Le Roi-CLEVELAND Sinkers drill more feet of hole per shift . . . why they run at peak efficiency day in and day out . . . why they lower drilling costs on any job that requires a hand-held drill.

It's Le Roi-CLEVELAND *engineering* that gives you performance advantages that really pay off for you: Low air consumption. Easy handling. Strong rotation. High drilling speed.

Le Roi-CLEVELAND has a complete line of sinkers from 18 to 80 lbs. Your Le Roi representative can show you why you're money ahead with any one of them. See him soon.

Write for free Bulletin No. RD25.

CLEVELAND ROCK DRILL DIVISION
Le Roi Company
A Subsidiary of Westinghouse Air Brake Co.
12500 BEREA ROAD • CLEVELAND 11, OHIO
Plants: Milwaukee, Cleveland and Greenwich, Ohio



H23 — 83-pound sinker Dry and wet types. 1"x4¼" hex or quarter-octagon. 1¼" or 1⅛" lug shank. Designed for shaft sinking in hard rock or bad, faulting ground . . . general drilling with heavy steel in hard rock.

H10 — 45-pound sinker Dry, constant blowing, and wet types. ⅞" x 3¼" and 1" x 4¼" hex or quarter-octagon chucks. Wet automatic dust-control back-head, if desired.

H166 — 33-pound sinker Wet and dry types. ⅞" x 3¼" chuck. Recommended for hard coal. Also ideal for wet or dry drilling in shale, limestone, sandstone, etc.

H22 — 18-pound sinker Wet and dry types. ⅞" x 3¼" chuck. Recommended for: Drilling holes for trolley hanger bolts. Cleaning up roof. Clearing out rock falls. Brushing bottom. Drilling oversize pieces at grizzley. Cutting hitches.

H111 — 55-pound sinker Dry, constant blowing, and wet types. 1" x 4¼" chuck (⅞" x 3¼" and popular sizes of quarter-octagon and lugged steel chucks also available.) Wet automatic dust-control back-head, if desired. Primarily designed for hard rock, but equally efficient in soft and medium formations.

Air-feed mountings up to 10′ steel changes.

RD-52

DRILLING *The Drillmobile has been leveled by its three hydraulic jacks. Operator at right is drilling a hole in a burn-wedge cut, while the operator at left is drilling a top relief hole.*

SLABBING *The jibs are swung back to line the machines for drilling outside slab holes.*

IN THE ROOF *The jibs can be raised and extended to drill a horizontal hole at a height of 15 feet.*

JOY . . . Since 1851—more than 100 Years of Engineering Leadership

DRILLMOBILES

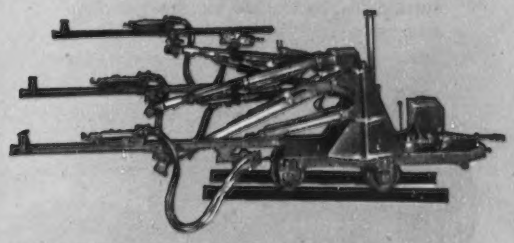
DO every job - SAVE everywhere!

The versatile, fast-tramming Joy DRILLMOBILE can mount one, two or three Hydro Drill Jibs. It has tractor-type steering so it can inch into shoe-tight drilling locations and worm around extremely short curves (it can actually turn in its own length).

Hydraulic control of the Jibs is a cinch to eliminate hard labor, promote safety, and speed up drilling. Three hydraulic jacks keep the Drillmobile level and steady while drilling. You'll find hole positioning is easy and accurate. Then, too, there's no drill misalignment with a Drillmobile, so steel breakage is reduced . . . *fast!*

Drillmobiles come in two models—one for large drifts and stope work, and a "Junior" that'll do a man-sized job in small-section drift work. ● For tips on how to put your drilling on a paying basis, write for Bulletin 87-F. **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

JOY HYDRO DRILL JIB *Air hydraulic control of all jib movements eliminates heavy lifting and permits more accurate hole spotting for more efficient use of powder and controlled breakage.*



JOY TRIPLE JIB JUMBO *Track-mounted unit similar in many ways to the Drillmobile. Booms are quickly raised or lowered to any position. Truck is held rigid and solid by a 20-ton hydraulic jack.*

TRAMMING *The Drillmobile travels under its own power. It can be easily converted to free wheeling for towing.*

Consult a Joy Engineer

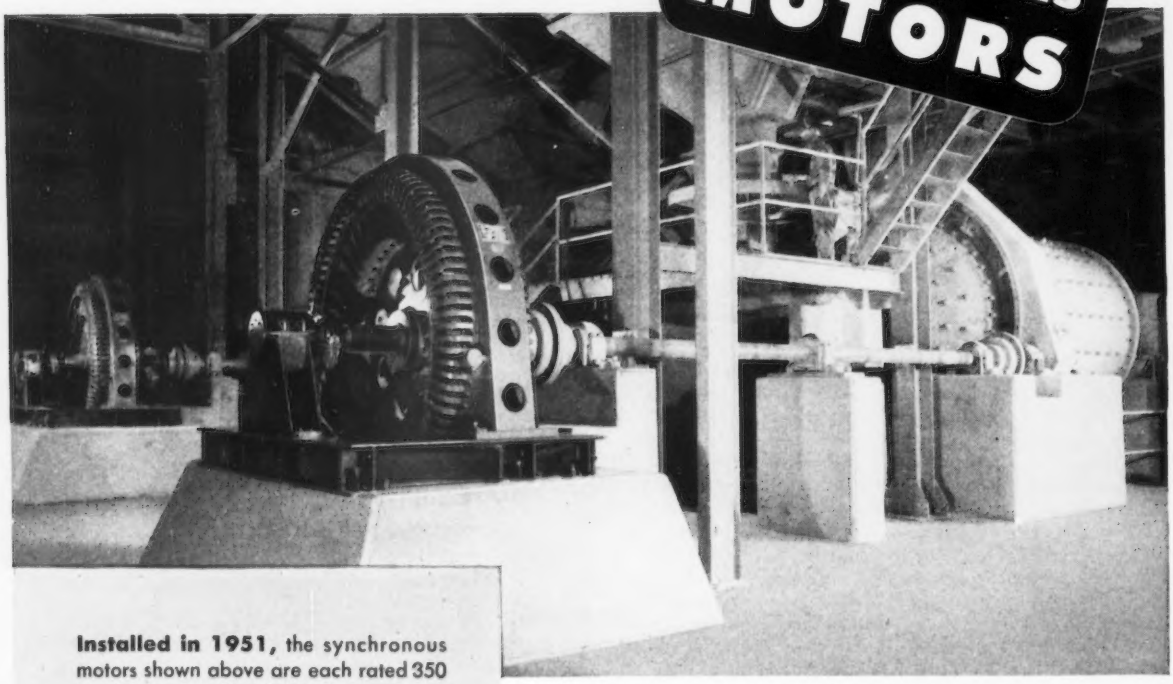
JOY

WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT

W&D M4392

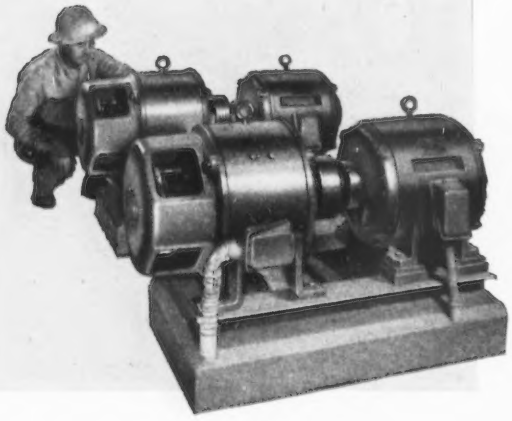
Built for a Long Grind

ALLIS-CHALMERS
Synchronous MOTORS



Installed in 1951, the synchronous motors shown above are each rated 350 hp, 80% pf, 440 volts, 180 rpm.

The 8 by 12-ft ball mills were furnished by Allis-Chalmers, along with the 15-kw m-g sets (shown below) which supply the excitation for the grinding mill motors.



Here are three reasons why Allis-Chalmers grinding mill motors help keep your mills grinding economically year after year:

Each motor is engineered for its job. A-C's half century of experience building electrical equipment *and* processing machinery assures torque and other operating characteristics tailored to the individual installation requirements.

Time-proved basic design features contribute to long life and trouble-free operation. These are described in detail in Bulletin 05B7648.

Adequate manufacturing, inspection and testing facilities insure that each motor will be built exactly as specified.

For more information on motors that minimize maintenance and down time, call in your A-C representative, or write for illustrated Bulletin 05B7648. Allis-Chalmers, Milwaukee 1, Wisconsin. A-4150

ALLIS-CHALMERS

ROCK is this Company's Business!

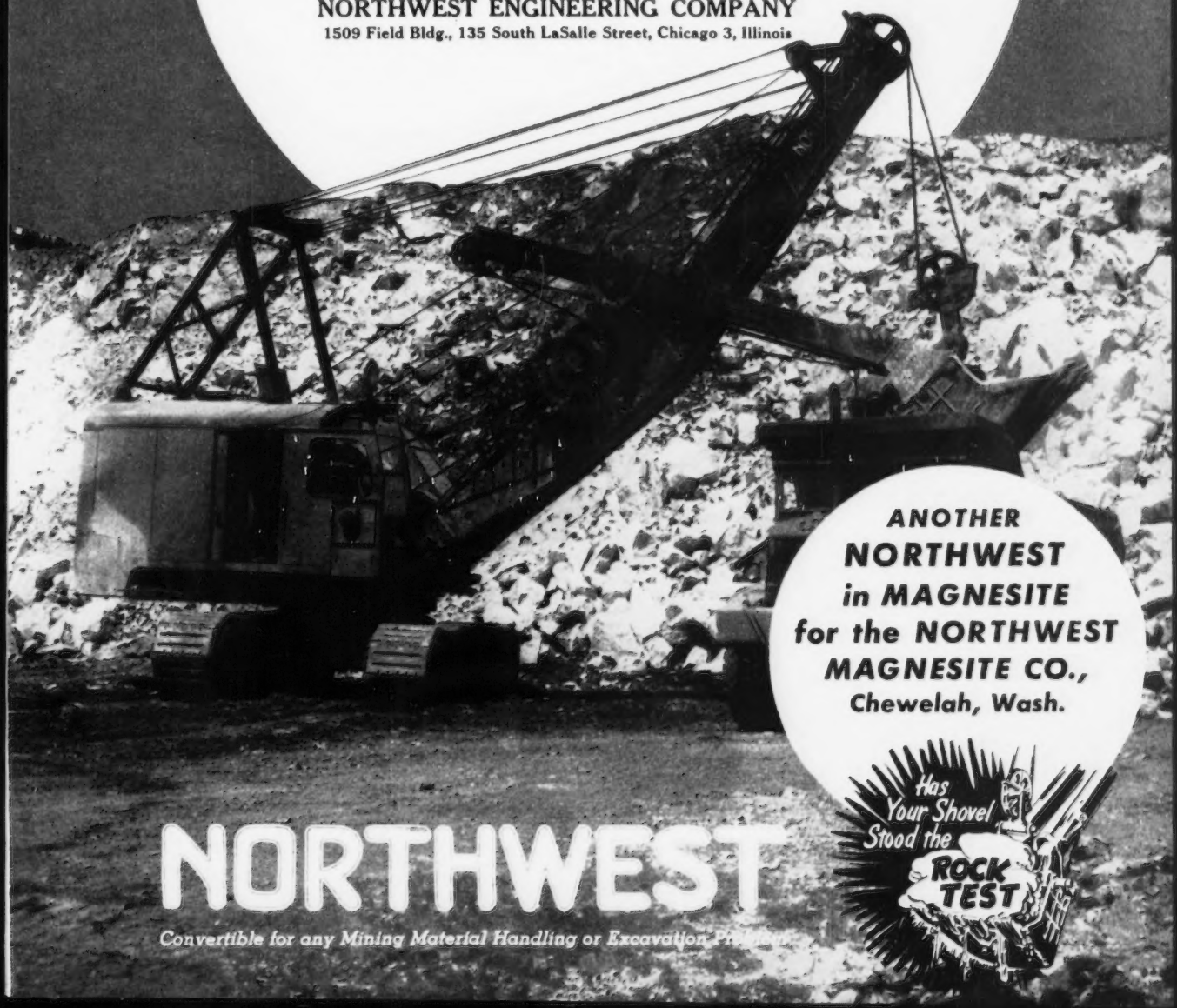
HERE'S as nice a bit of shovel busting material as anyone would like to stick a machine into! This is magnesite, a dense, compact and rare mineral used in furnace lining and as a source of magnesium.

The Northwest is owned by the Northwest Magnesite Company of Chewelah, Wash. *(no relation to us)*, and it's the second Northwest this company has purchased.

Northwests are meeting the "rock test" on jobs like this all over the country. Your Northwest is a *real* Rock Shovel and when you have a *real* Rock Shovel you don't have to worry about output in any kind of digging. Greater crowding force, smoothness of dipper control, easier operation and accuracy in spotting are just a few of the advantages that Northwests bring you. They are advantages that mean money on all hard rock work.

Northwest dependability and high output has made one out of every three Northwests sold a repeat order. There is no better testimonial!

NORTHWEST ENGINEERING COMPANY
1509 Field Bldg., 135 South LaSalle Street, Chicago 3, Illinois



ANOTHER NORTHWEST in MAGNESITE for the NORTHWEST MAGNESITE CO., Chewelah, Wash.

Has Your Shovel Stood the ROCK TEST

NORTHWEST

Convertible for any Mining Material Handling or Excavation Pr...

ANSWERING THE CALL FOR GREATER OUTPUT

It takes truly modern equipment to keep pace with today's stepped-up demands — and do it at an operating cost which insures fair and consistant profits. This line of Allis Chalmers equipment has been designed and built completely new since the war, with the kind of advanced engineering that delivers big-capacity performance at a minimum of maintenance costs. It is the line that's Designed For Your Job . . . Built To Take It . . . Easy To Operate . . . Easy To Service.

Shock Troops Of Production. Crawler tractors equipped with bulldozers handle countless stripping, excavating and other earth-moving jobs. Wide choice of bulldozers—straight or angled, cable or hydraulic — assure the right combination for maximum production on every job . . . enables users to strip overburden previously thought too deep to tackle profitably. Allis-Chalmers offers a choice of four crawler tractors to meet your needs from the 40 hp. HD-5 to the giant HD-20 with torque converter drive and 175 net engine hp.

Flexible Excavators and Loaders. Front-mounted hydraulic shovels for all four models of Allis-Chalmers crawler tractors handle many excavating jobs, load trucks, other hauling units . . . feed hoppers and conveyers. Buckets range from one cubic yard on the HD-5G to four cubic yards on the HD-20G. Special rock buckets and rock forks are also available.

Fast, Self-Hauling Scrapers. On stripping, hauling and dumping jobs, Allis-Chalmers Motor Scrapers move big yardage "on the double." These job-tested, job-proved machines have unusually high horsepower-to-yardage ratios, assuring top-average haul speeds even when loaded and on adverse grades. Their clean, open-top design also permits easy shovel loading. Other features, such as positive, forced ejection, high clearance, hydraulic power steering and simplified servicing add still further to production output. Model TS-200 has a 10 cu. yd. struck and 13 cu. yd. heaped capacity; TS-300 has a 14 cu. yd. struck and 18 cu. yd. heaped capacity.

Road Builders and Maintainers. Low-cost, tandem drive Model D easily handles maintenance as well as many construction jobs. With exclusive ROLL-AWAY moldboard, tubular frame and other high-production features, it gives big grader performance advantages at a fraction of the usual cost. For heavy grading and construction, four diesel powered models are available.

Your Allis-Chalmers dealer invites you to stop in and discuss your job requirements. He will be glad to help you select the right machine for your needs.

Tough, Speedy Hauling Units. Model TR-200 rear-dump Motor Wagon is built to take rock-shock. Double steel floor is reinforced with heavy oak plank. Front and sides are channel ribbed to provide rigidity. Clean interior, high 70-degree tilt plus constant wheel-base insures fast, safe and complete load ejection. Wagon body is interchangeable with TS-200 Scraper Body. Model TW-300 bottom-dump Motor Wagon is interchangeable with TS-300 Scraper Body.

For Big Stripping Jobs. Allis-Chalmers tractors team up with pull-type scrapers to handle big stripping and stockpiling jobs. Your Allis-Chalmers dealer offers a choice of seven models to fit every tractor and every job. Struck capacities range from two to 18 cu. yd.

ALLIS-CHALMERS
TRACTOR DIVISION—MILWAUKEE 1, U.S.A.

ROLL-AWAY is an Allis-Chalmers trademark.

If you do this to a cable...

you'll want *flexible* G-E Type SH-D

When you're trying to get out the maximum tonnage each hour, cables usually take a beating. Bending, pulling, and crushing of portable cables are common causes of cable failure. To meet these conditions, use G-E Type SH-D Geoprene portable cable. With this cable you'll obtain longer cable life with consequent low replacement cost—what's more, you'll obtain easier handling and increased protection to equipment and personnel. General Electric's Type SH-D construction contains unique features of flexibility and durability which best protect this type of cable against the service abuses encountered.

Its flexibility means long life and protection to equipment and personnel

The ground wires are minutely stranded with a short lay for maximum flexibility and are approximately equal in total cross section to one main conductor. Each is encased in braid so that, when bent, the wires will slide rather than break. As a result, this cable has never, to our knowledge, had a single case of failure from broken ground wires. This flexibility and the large cross-sectional area of the ground wires reduce the hazards of faults.

The shielding is a combination cotton and copper braid which is more flexible and therefore less subject to breakage than an ordinary all-copper braid. Yet it has a copper content that gives full shielding protection against corona.

The treated jute fillers permit internal movement of the conductors to relieve strains caused by bending.

All of these features of flexibility make the cable last longer, and make it easier to handle and to move.

Its durability prolongs cable life

The strength, toughness, and resistance to fire, oil, and corrosives of Geoprene cables have been proved by many years of service. Also in G-E Geoprene Type SH-D cables the inner and outer jackets and the reinforcing corded mesh are bonded together like a reinforced tire for maximum resistance to pulling stresses, crushing, and abrasion—and for longer cable life.

For uninterrupted operation of shovels, draglines, loaders, and other heavy portable equipment, and to reduce cable replacement costs—investigate G-E Geoprene Type SH-D portable cables. General Electric has a full line of wires and cables to meet the needs of the mining industry. For more information, write Section W105-995, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

You can put your confidence in—

GENERAL ELECTRIC

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

PERFORMANCE PAYS OFF!

THE tires you buy or specify can help keep you ahead of schedule—or drop you into a mess of dead equipment, idle men and busy red ink.

Goodyears are the best workers—the longest wearers—the tires *specifically designed* to thrive on your kind of jobs—to give you lower costs per hour.

It takes worlds of experience to build such tires—and Goodyear has it. Goodyear has built more tires for more specific purposes than anyone else on earth. So when you buy or specify Goodyears, you're buying the tires that can put more money in your pockets. Goodyear, Truck Tire Department, Akron 16, Ohio.

HARD ROCK LUG
for stamina and full pull, forward or reverse, on all kinds of tire-killing work.

HARD ROCK RIB
for front wheels on all tire-killing service. Rugged—smooth rolling—easy steering.

ROAD LUG
for toughness and super-traction OFF the road and long, smooth mileage ON the road.

FOR EACH JOB, THERE'S A COST-CUTTING GOODYEAR TIRE!

America Needs Better, Safer Roads — Let's Bring them Up to PAR

Road Lug—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

GOODYEAR

MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

We think you'll like "THE GREATEST STORY EVER TOLD"—every Sunday—ABC Radio Network. —THE GOODYEAR TELEVISION PLAYHOUSE—every other Sunday—NBC TV Network

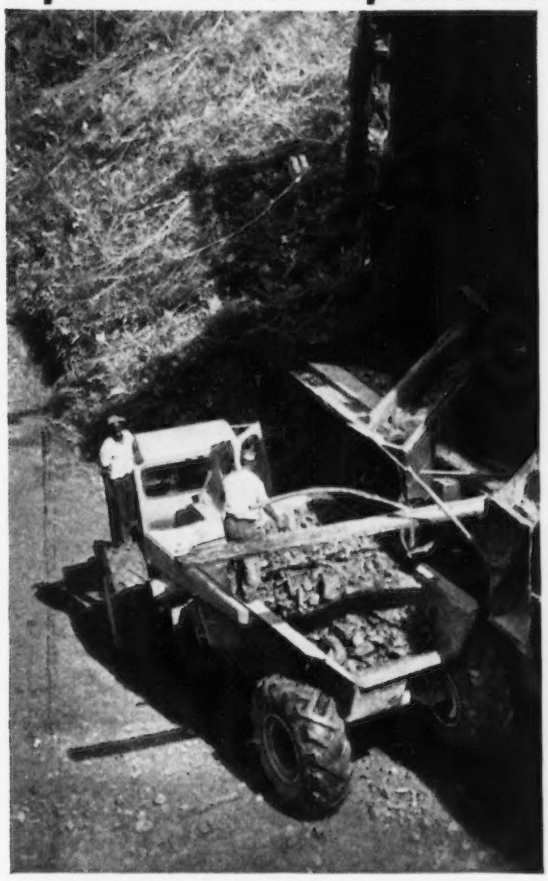
Pictures of the month... *by LeTourneau-Westinghouse.*

TURNS IN 26-FOOT-WIDE CUT — Ability to turn in a box cut or on a narrow roadway is an important time-saver in many pits. This picture from Brazil well illustrates the unique turning ability of Tournarockers. Here the 16-ton "C" eliminates a 1000-ft back-in to the shovel by turning non-stop in a 26-ft wide cut. "Tournarockers' short turn radius (10½ ft with bowl raised) saves construction of access roads and turn-arounds," says Giovanni Sala, project mgr for owners Beretta & Novi. Cuts on this railroad relocation range from 50 to 100 ft deep, so turn-arounds would be very expensive. Besides the 2 Tournarockers, Beretta & Novi own 10 Tournapulls. They report, as typical output, 78,000 yds in 100 days for 2 Tournarockers in shovel-loaded sandstone and clay . . . 314,000 yds in 100 days for 6 Tournapulls push-loaded in sandy loam and clay. Hauls for all equipment averaged 4250 ft.

CLEAN OVER-EDGE DUMP — With front-wheel drive, Tournarocker backs safely to edge of bank. Loads fall free and fast. Little or no dump clean-up is required. Says Red Parrot Coal Co Supt F. Mason Morgan, user of unit shown, "Tournarocker works better than any rubber-tired equipment we've used."

COMPACTS COAL — Public Service Electric & Gas Co, Camden, NJ, hauls 208 tons of coal hourly from conveyor to stockpile with Tournatractor-Carryall team. On 760-ft cycles, "C" delivers 16 tons every 4½ min. Rig's big tires effectively compact, seal coal against spontaneous combustion.

. . with performance reports from around the world



FLYING GOLD-MINER — To reach isolated mine in center of Nicaragua, this 9-ton Tournarocker was cut apart and flown 110 mi over the jungle. Re-welded at job, it now hauls gold ore and waste to crusher. In typical month, it worked 356 hours, hauled 4698 tons. Hauls averaged 9800 ft, all up-grade, with 9500 ft at 3 to 10%, 300 ft at 12 to 20%.

FIRE-FIGHTER — In Missouri, Tournatractor helps combat stockpile fire by spreading burning coal. Continued use of this machine will greatly reduce possibility of more spontaneous combustion fires. Its big rubber tires compact coal and eliminate air spaces during normal travel across stockpile.

DOUBLE-HEADER — This Tournatractor means business at both ends. Crane boom, designed by Standard Sand & Silica Co, Davenport, Fla, lifts with regular LeTourneau-Westinghouse motor, has 3-ton capacity. Front end mounts standard dozer blade.

50 TONS EVERY 4½ MINUTES — Stripping overburden from two soft coal veins near Clearfield, Pa, this big Model A Tournarocker carries 50 tons of slate, shale and clay per load. Time for complete 400-ft cycles averages only 4½ minutes.

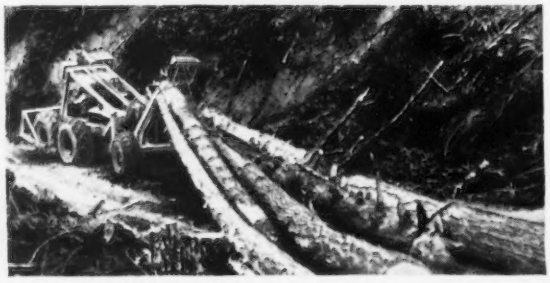
MORE THAN 1 WAY — When not needed for scraper work, J. W. Crowder, Houston, uses his C Tournapulls to haul from a dragline. Here, rig gets heaped load of tightly-compacted gumbo on dam and spillway construction job along the Sabine River in Texas. Unit made 2000-ft cycle in 3½ minutes.

(continued on next page)

Pictures of the month... *by LeTourneau-Westinghouse.*

2½ MIN TO LOAD — It isn't often you see a big rig like a D Tournarocker loaded by a front-end loader. But Ft. Hartford Stone Quarry of Olaton, Kentucky teams the two to provide 100% of their limestone . . . and does it profitably! Their 9-ton Tournarocker takes 5 to 6 passes from the 1¼-yd bucket . . . is loaded with shot rock in 2 to 3 minutes. Complete 600-ft cycle to crusher takes 4 minutes "Thoroughly sold on Tournarocker for this work," says A. C. Hall, Company President.

15¢ PER YD — For crusher, A. T. Waltenburg, Jackson County (Oregon) Hwy Supt, needs 500 tons of gravel per 8-hr day. He brought in a 9-ton D Tournarocker to replace 2 trucks. The one Tournarocker averages 64 yds hourly to deliver all gravel crusher can handle. "A real money-saver," says Waltenburg. "Moves dirt for under 15¢ a yd." Major saving is on repairs. Tournarockers' big tires absorb shocks. Unit has no frame, sub-frame, springs, spring hangers, hinged axles, hydraulics . . . hence is seldom in shop.



POWERFUL WINCH — Fast electric controls and 67,000 lb line pull make Tournatractor ideal for towing trucks out of mud or skidding equipment. Here, it tows enough Douglas fir for a bungalow (about 7000 bd ft). Owner is Roy Monschke, Fortuna, Calif.

STRIPPING FOR STEEL — To meet a vastly increased demand for limestone from the steel industry, Kelley Island Lime & Transport Co, Cleveland, works 2 C Tournapulls 16 hrs per day stripping limestone at their Marblehead quarries. The 2 units combined remove 418 to 436 bank yds of rocky loam overburden per 50-min hr. Hauling over rough, winding roads and up 1 to 10% grades, Tournapulls complete cycles of 2200 ft in 2¾ minutes.

. . with performance reports from around the world

HEAVE-HO — Two ages meet on the Black Sea at Kozlu, Turkey. In the background, natives beach fishing boats just like their ancestors did hundreds of years ago. In the foreground, a modern high-speed Tournatractor lifts the loads from hundreds of aching backs as it levels spoil hauled by eight 22-yd trucks from the Eregli Coal Fields, Turkey's newest coal mine.

DOZES WET CLAY — Almost 1,000,000 yds were filled into Lake Michigan near Milwaukee recently to build a 900 x 900-ft coal dock. "Tournatractor handled output of 7 scrapers," reports Operator L. Derk. "One day, when rigs were on 600-ft haul, I dozed 6,390 yds into the lake. Also helped crawlers through the spread. Even had time to travel uphill to clean the cut."

NO TIRE BREAKAGE — After months of double-shift hauling of Florida pit rock, Maule Industries Inc report no tire troubles on their 18-ton Tournarocker. Its big 21.00 x 25 single tires rolled easily over blasted rock or quarry floor. Smaller 6 and 12 yd trucks, used on same hauls lost time due to blowouts and other tire damage. This was caused mostly by rocks wedging between the duals, or concentration of weight on a single small tire when rolling over rock fragments. Tournarocker and trucks brought shot limestone 1.8 to 2.2 miles from pit to crusher. For complete facts on this and other units shown on these pages, write LeTourneau-Westinghouse Company, Peoria, Illinois.

LeTOURNEAU WESTINGHOUSE

Tournapull, Tournarocker—Trademark Reg. U.S. Pat. Off., Tournatractor—Trademark Pic. 483-M

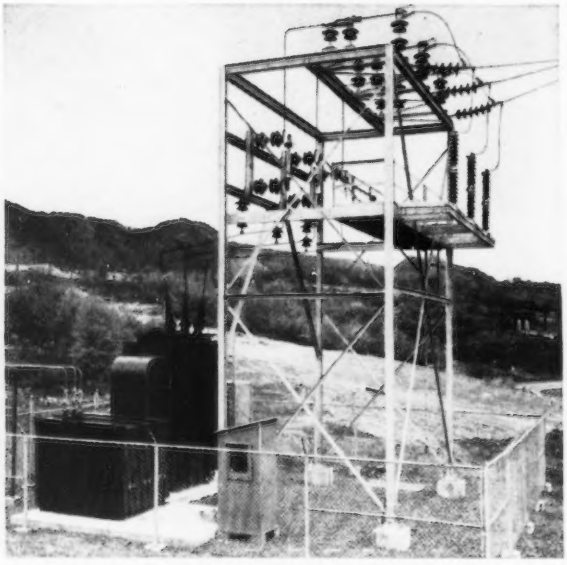
GE ENGINEERING REPORTS:

Photograph courtesy of Kennecott Copper Corporation

1 STEP UP SHOVEL SPEED, CAPACITY. This shovel performs faster, more smoothly, thanks to its simple, rugged G-E drive system. Usable torque is increased. Response and acceleration are improved. Amplidynes, which control shovel motions precisely, prevent excessive current and torque peaks which might damage electrical and mechanical equipment.

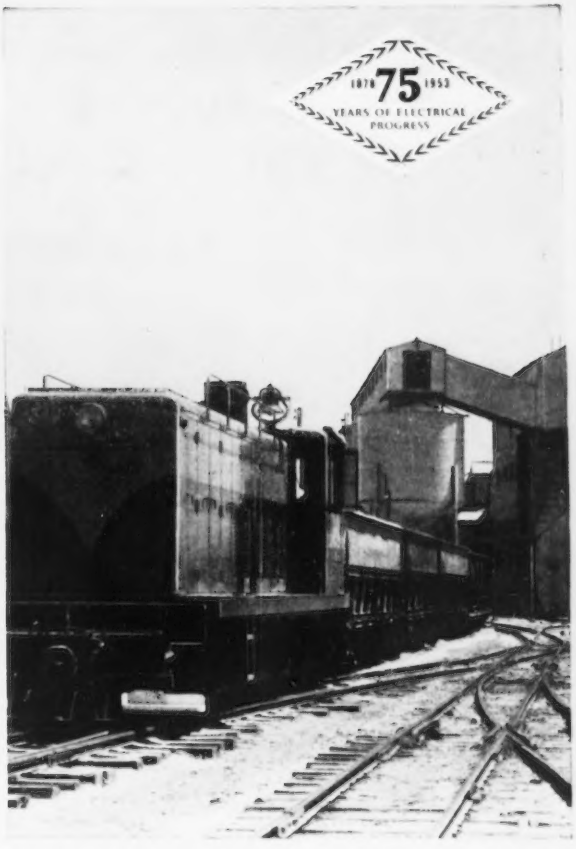
5 ways modern electrification can

4 MAKE POWER SYSTEM MORE FLEXIBLE. This standard G-E cable-skid switch house has polarized couplers to simplify and speed up cable interchanging. Skid house is easy to move.



5 IMPROVE POWER SYSTEM PROTECTION. Magne-blast breakers in G-E master unit substation protect feeders; lightning arresters help guard substation against outage.

2 **INCREASE DRILL FOOTAGE.** This self-contained churn drill, powered by G.E., delivers rapid rock penetration promoting more efficient drilling and blasting practices.



3 **HAUL MORE ORE.** General Electric 70-ton diesel-electric locomotive has high availability. It maneuvers rapidly, efficiently, helps speed all switching operations.

help you mine more tons per day

G-E engineered electrical systems mean faster open pit mining at less cost

You need speed, flexibility, and safety in your open pit mining operations if you are to meet present demands for higher production per man-day. ***Modern electric power*** is the key. Here's what it helps you to do.

1. You can speed up the digging cycle. G-E amplidyne-controiled drives provide faster hoist, swing, and crowd action on power shovels. Shovels work around the clock with minimum time lost for maintenance or repairs.

2. You can step up drilling efficiency. Modern rotary and churn drills, powered by General Electric, are self-propelled. Smooth, fast motor control helps them to drill harder rock at higher speeds.

3. You can haul greater tonnages. G-E diesel-electric locomotives withstand hard work cycles. Units can be operated close to the wheels' slipping point even with heaviest loads.

4. You can cut re-location time. G-E cable-skid switch houses give a more flexible power system arrangement. Moving is simplified. Cable connecting time is minimized.

5. You can increase mining efficiency and safety with portable G-E unit substations. They improve voltage levels—make full equipment capacity available. Distribution losses are reduced. Grounding systems help protect personnel and equipment.

These production-boosting techniques can be applied to your surface mining operation. A G-E mining industry specialist can show you how. Contact him at your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, New York.

660-29

Engineered Electrical Systems for the Mining Industry

GENERAL ELECTRIC

Uneven, Intermittent Flow

DO YOU SUFFER FROM ANY OF THESE CONVEYING "HEADACHES?"

Abrasive or Sharp Edge Material

Steep Inclines

High Tonnages

Heavy Loads

Material Too Hot to Handle

A Rex Pan Conveyor carrying hot ore nodules from kiln to railroad car up a 25-degree incline.

you need a

REX Apron or Pan Conveyor

Hot or cold, free-flowing or lump, abrasive or non-abrasive, you name the material, and we'll show you how to handle it better...cheaper... easier with a Rex Apron or Pan Conveyor.

Your Rex Conveying Engineer has years of experience in solving difficult materials handling problems, and he's backed by a complete line of Rex Apron and Pan Conveyors as well as the finest in belt idlers. He can recommend without prejudice the exact type of conveyor which best suits your particular application. He'll explain in detail the advantages of Rex design and construction. For instance:

★ **Unique outboard roller construction permits easy servicing without disassembling chain or conveyor.**

★ **Exclusive Rex Square Through Rods seated in square holes in side plates positively cannot rotate.**

★ **Only a minimum of mechanical servicing is required.**

★ **Steep inclines are practical.**

★ **Power requirements are low because of large diameter outboard rollers.**

Want more information? It's as near as your telephone. Call your nearest Rex Field Sales Engineer or write to Chain Belt Company, 4709 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT REX COMPANY ®

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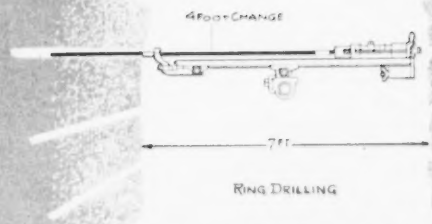
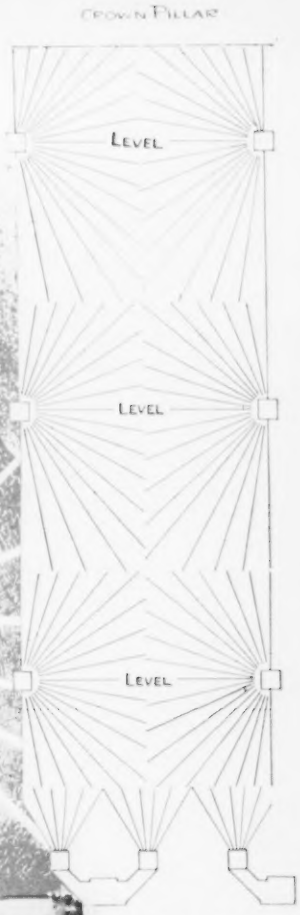
Distributors in principal cities in the United States and abroad

Export Offices: 4800 W. Mitchell Street, Milwaukee, Wisconsin; and 19 Rector St., New York City.

GARDNER-DENVER is first again!

now it's the "Blast Hole" drill designed especially for percussion deep hole drilling





the NEW Model SFH99

A Natural Partner — with Carbide Bits and Superior Gardner-Denver Alloy Sectional Rods and Couplings — for Low Cost Blast Hole Drilling.

Permits a 4' change in a 7' drift—saves time and development work.

Superior chuck construction—1½" x 3 15/16" shank rod locked in chuck—results in longer life for hammer, tube, chuck, shank rod and ring seal.

Locked-in shank rod prevents loss of rod string on down holes.

Heavy-duty centralizer supports rod string during rod changes—simplifies up-hole drilling.

Reverse rotation and locked-in shank rod enable operator to uncouple rods quickly and easily—using power from the drill and only one wrench.

Delivers high-pressure water or air through chromium plated tube and Ring Seal Shank.

Lightweight aluminum alloy guide shell—reversible for extra life. Movable cone.

Write today for complete details.

SINCE 1859

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
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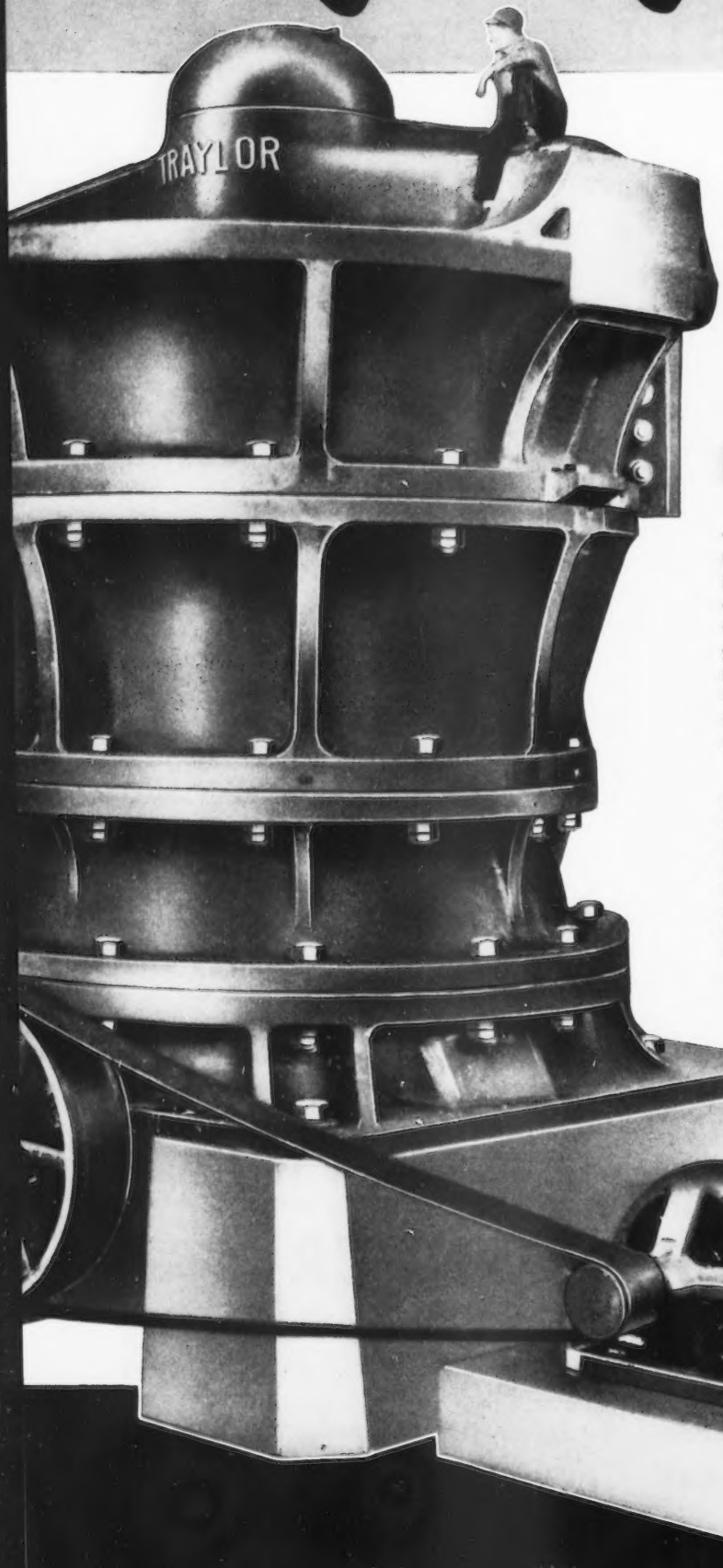
THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS
FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

BIG Gyratory Crushers



THE 6th 60" GYRATORY BUILT BY TRAYLOR

"Traylored" to produce 30,000 tons per day, the latest of Traylor's super-size 60" Gyratory Crushers is on its way to the famous copper mine at Chuquicamata, Chile. This crusher is equipped with Traylor's original curved concaves and bell head.

Some idea of the weight of this gigantic machine can be judged from the relatively small eyebolt used to lift the shaft. It weighs over half a ton. The cast steel frame of the crusher is over 5" thick at several points.

Traylor built the first successful 60" Gyratory in 1919 . . . 34 years ago. It proved that a gigantic crusher with high hourly capacity could effect amazing production economies. This first 60" was sold to a Michigan limestone producer. Because of its outstanding efficiency, this same customer purchased their second 60" Traylor Gyratory four years later. Of these 60" crushers, three are in Michigan, one in Arizona, one in England and one in Chile. Capacities up to 3500 tons per hour.

A **Traylor** LEADS TO GREATER PROFITS

Since 1919

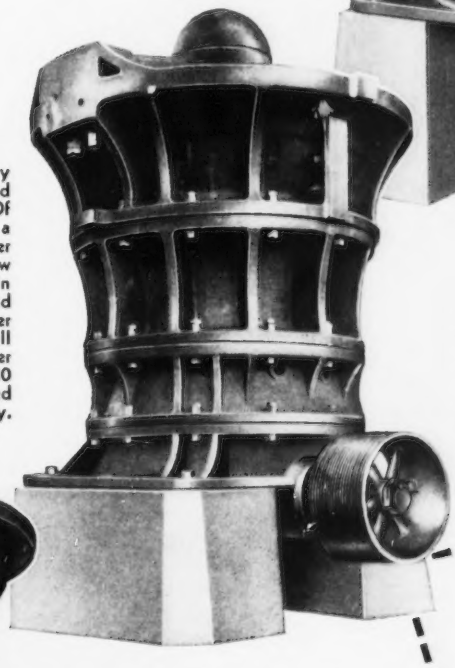
are "Traylor-MADE"

Result: Traylor has acquired special skills and facilities for building these big machines.

With 38 of these huge Gyratory Crushers in the field, Traylor design and construction have been proved under a wide range of operating conditions. To match this accumulated "know-how," Traylor has expanded facilities to build these big crushers with precision and efficiency. Consequently, the producer who needs 645 to 3500 tons hourly production will find the Traylor TC a crusher of unusual operating economy and dependability. Write concerning your requirements. Let us show why it pays in the long run to buy a Gyratory "Traylored" to your individual needs.

EIGHT 54" Traylor Gyratory Crushers are in the field; four in Canada, one in England, one in Mexico, one in Michigan and one in Nevada. These crushers are used to help produce cement, nickel, copper and iron. The Traylor 54" Gyratory has hourly capacities from 1400 to 2240 tons.

FOUR 48" Traylor Gyratory Crushers have been built and TWO are in the works. Of those in the field, one is in a Pennsylvania ore mine, another is crushing trap rock in New Jersey, still another is in Minnesota on iron ore and the fourth in Nevada on copper ore. The two in the works will be crushing iron ore and copper ore. Capacities up to 1980 tons per hour are obtained with the 48" Traylor Gyratory.



EIGHTEEN 42" Traylor Gyratory Crushers are in a wide range of service. One is in Chile, two in Canada and the rest dispersed over 14 different states. The 42" Traylor Gyratory provides capacities up to 1290 tons per hour.

FOR MORE INFORMATION
mail this coupon today to . . .

TRAYLOR ENGINEERING & MANUFACTURING CO.
1. 'z MILL ST., ALLENTOWN, PA.

Send me complete facts about the Traylor TC Gyratory.

Name: _____

Position: _____ State: _____

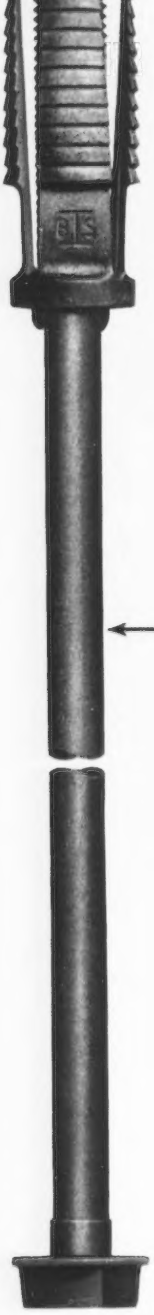
Company: _____

Address: _____

Sales Offices: New York • Chicago • San Francisco
Canadian Mfrs: Canadian Vickers, Ltd., Montreal, P.Q.

Traylor has built 38 of the world's biggest crushers

There's Less Chance of Accidents with Roof Bolting



Roof-fall accidents are less likely to occur when entries and air-courses are equipped with roof bolts. For with this economical method of roof support, the bolts bind together the overhead strata, consolidating them into a single-unit, thick beam.

In addition to providing a roof that's secure, roof bolting also offers mine operators these important advantages:

1. Increased production.
2. Elimination of timber supports.
3. Improved ventilation.
4. Wider mine openings, and greater side clearances.
5. Faster haulage.

You can obtain these ideal conditions by using either of two types of roof bolts made by Bethlehem—the slotted type or the square-head type. Full information about either bolt may be obtained by writing to us at Bethlehem, Pa.

SQUARE-HEAD ROOF BOLT. With expansion shell. A rolled-thread bolt with unchamfered head. Fits $1\frac{3}{8}$-in. hole. Pressed ears on shank support shell during anchoring. When bolt is tightened, leaves of shell expand to provide holding pressure. By locking against sides of hole, leaves prevent shell from turning during installation.

SLOTTED ROOF BOLT. Has forged slot to accommodate steel wedge. Slot is automatically centered, forming equivalent of two half-rounds. Opposite end of bolt has 5 in. of 1-in. rolled threads. When driven in $1\frac{1}{4}$-in. hole, wedge penetrates slot, spreading bolt-end. Truncated-cone point prevents thread damage. Fitted with American Standard Regular Square Nut.

★ BETHLEHEM STEEL ★

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM MINE ROOF BOLTS

"Save money?

Sure!"

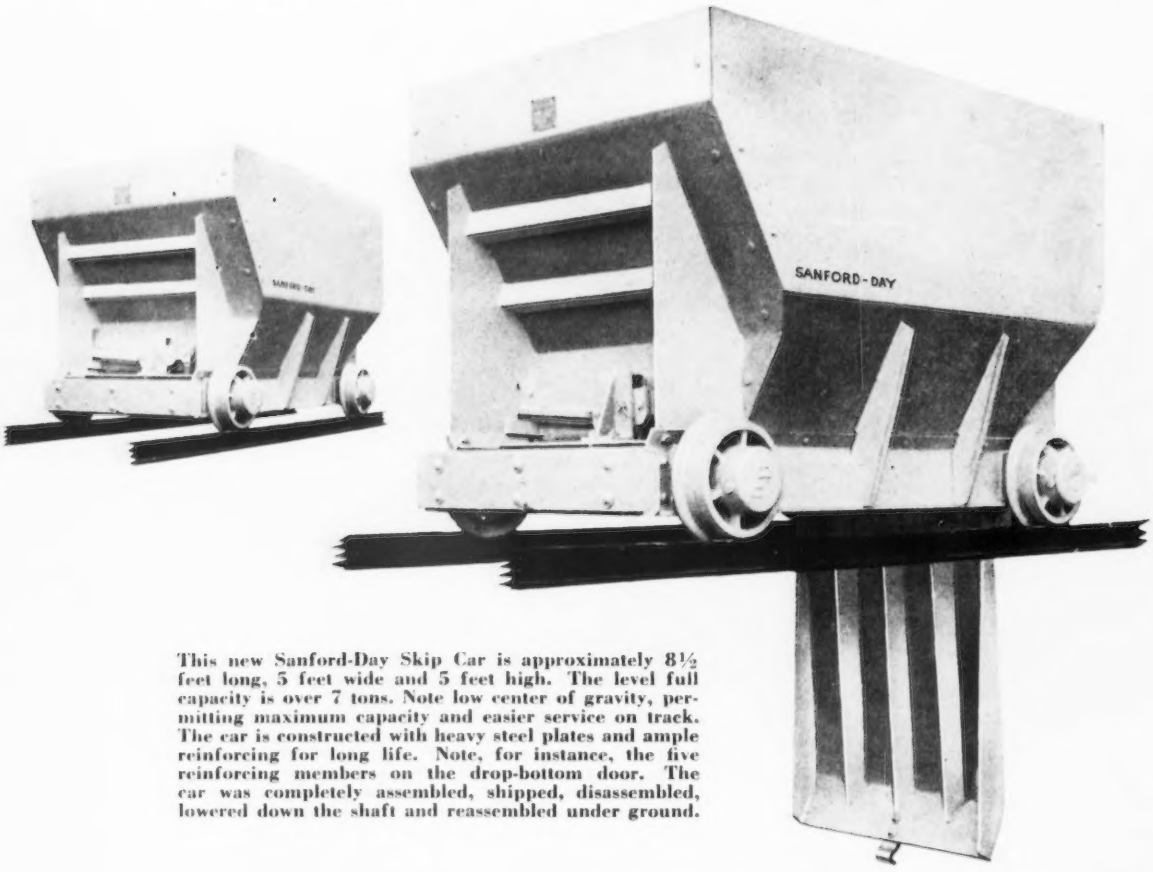
THAT, in a nutshell, tells you why so many wire rope users in the mines prefer Roebling wire rope . . . it speeds up operations . . . lasts longer on the job . . . saves money that really adds up.

For the last word in wire rope efficiency and economy, call your nearest Roebling office or distributor for a Roebling recommendation.

ROEBLING
A subsidiary of The Colorado Fuel and Iron Corporation

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, N. J.

New One-Door Bottom Dumping Skip Car Built for Development Work at Resurrection Mine



This new Sanford-Day Skip Car is approximately 8½ feet long, 5 feet wide and 5 feet high. The level full capacity is over 7 tons. Note low center of gravity, permitting maximum capacity and easier service on track. The car is constructed with heavy steel plates and ample reinforcing for long life. Note, for instance, the five reinforcing members on the drop-bottom door. The car was completely assembled, shipped, disassembled, lowered down the shaft and reassembled under ground.

To work a new development at the Resurrection Mining Co. at Leadville, Colo., a 16° winze was required for moving material to two 100-ton capacity pockets located at top and directly beneath the inclined slope.

An automatic bottom dumping car was the only practicable solution. A short car, only 8½ feet overall, was required for loading by the mucker and therefore only one bottom-dumping door could be used. In addition, the bin lengths were only 10 feet, necessitating a short car.

In collaboration with the customer's operating officials, we designed and built this one-door type Sanford-Day Bottom Dumping Skip Car that solved the problem. The car is moved by cable and hoist, which is located about 60 feet beyond the pockets. A selective tripping device, mounted at one side of track, trips the car door at either pocket for discharging load.

We bring this new car to your attention as another example of Sanford-Day's ability and aggressiveness in solving the metal and non-metallic mine operator's many haulage problems. Regardless of what your mine car needs may be, it will pay you to let us engineer and build cars to suit your own requirements.

SANFORD-DAY IRON WORKS

SD

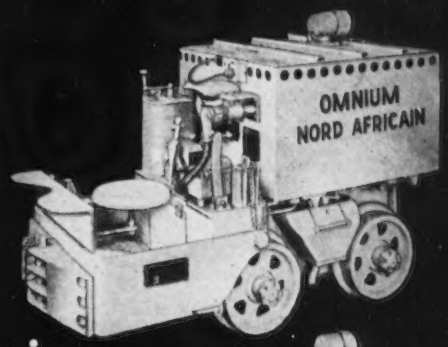
KNOXVILLE
TENNESSEE

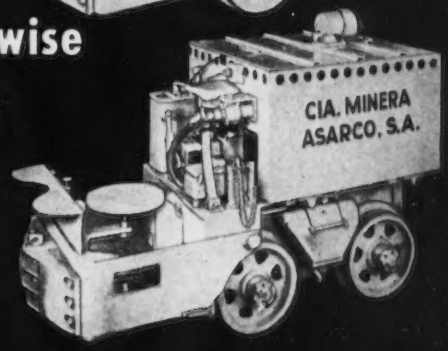
Count on MANCHA'S LITTLE TRAMMER

(STORAGE BATTERY LOCOMOTIVE)

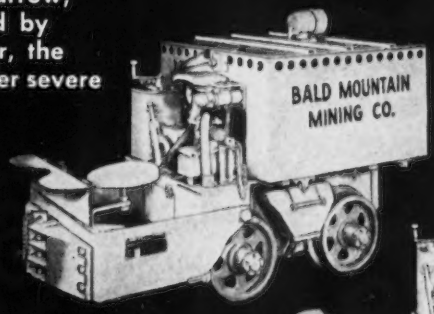
to do a big job — production-wise and profit-wise

Whatever the work at hand — haulage, moving mucking machines, drill jumbos, timber, powder, supplies, or man trips to distant workings — you can count on a Mancha Little Trammer to do the job dependably, quickly, and economically.

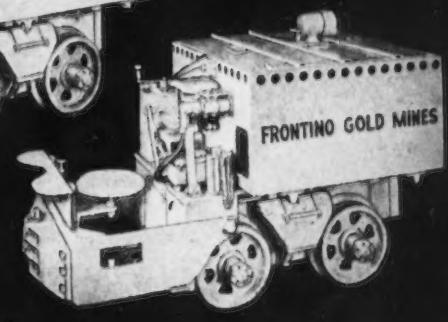




Small enough for work in narrow, crooked drifts, and powered by a rugged, heavy duty motor, the Little Trammer stands up under severe operating conditions — does a whale of a job, with complete safety for the motorman, and with minimum expense for operation and maintenance.



OPERATING WT., 1½ TONS
The hinged cab of the Little Trammer raises to shorten caging length, to facilitate transfer from level to level even in small mines.



Mancha's Little Trammers are doing a big job for mining companies all over the world

Will Mancha's Little Trammer pay in your mine?

You can find out quickly and easily. Just mail the coupon for our "mine haulage data form." The information you provide will be analyzed by Mancha Engineers, who will then tell you what economies you can effect with the use of this storage battery locomotive. Mail the coupon today. There's no obligation.

Mancha Storage Battery Locomotive
Division GOODMAN Manufacturing Company
4850 South Halsted Street, Chicago 9, Ill., U.S.A.
E AND MJ 953

Send your mine haulage data form.

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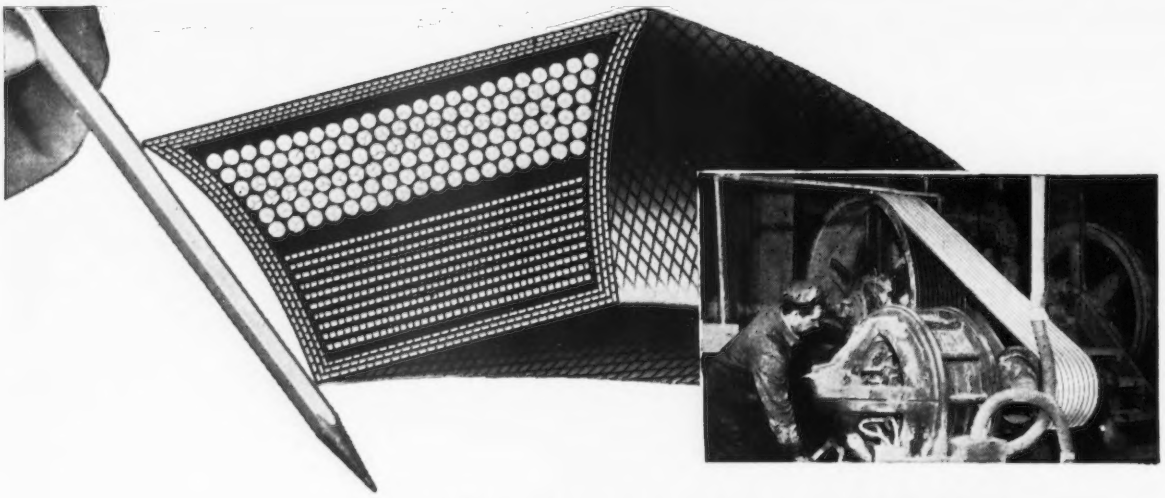

Gates V-Belts are built with CONCAVE SIDES

(U.S. PATENT NO. 1813698)

...that's why they last longer!

If you want lower V-Belt costs, just make this simple test...pick up *any* V-Belt and bend it as if it were going around a pulley.

As the belt bends, grip its sides between your fingers and thumb.

If the belt has *straight sides* you feel the sides bulge out. This forces the sides of the belt to press *unevenly* against the V-pulley . . . and you get concentrated wear at the points shown by the arrows.

Now, try this same test with the V-Belt that is built with CONCAVE SIDES **—the Gates Vulco Rope.**

As this belt bends, you can feel the CONCAVE SIDES *fill out* and become perfectly straight.

These sides press *evenly* against the V-pulley. All wear is distributed *uniformly* across the full width of the Gates Vulco Rope and the CONCAVE SIDES therefore mean longer belt life and lower V-Belt costs for you.

When you buy V-Belts, be sure to get the V-Belt with the CONCAVE SIDES—the Gates Vulco Rope!

Gates Engineering Offices and Jobber Stocks are located in all industrial centers of the United States and in 71 foreign countries.

CS 935

V-Belts — Hose
Molded Rubber Goods
for industry
World's Largest Maker of V-Belts

Gates® VULCO ROPE DRIVES

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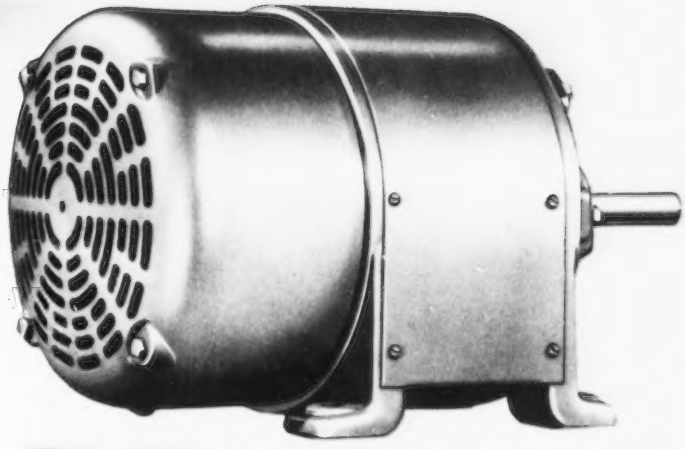
CERTIFIED

SAFE



TOTALLY-ENCLOSED

AND EXPLOSION-PROOF

U.S. MOTORS

100% Safe... U. S. TOTALLY-ENCLOSED MOTORS

Without equal for dependability, this advanced line of motors insures safest power and longest life. The vital elements are given utmost protection against external hazards. The explosion-proof types are certified safe by Underwriters' Laboratories, Inc.

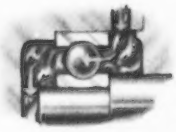
NORMALIZED CASTINGS

All castings normalized to remove internal stresses and maintain original accuracy of bearing settings and air gap between rotor and stator, insuring far longer bearing life.

HI-DRAFT VENTILATION

Ventilating fan is of non-sparking material for explosion-proof motors. Designed with split hub, permitting quick removal. Tight in operation. Multi-bladed for quietness.

LUBRIFLUSH BEARINGS



Self lubricated for normal life—and with the extra advantage of Lubriflush, permitting relubrication when desired without disturbing the bearings. Fresh lubricant is injected; old grease is purged.

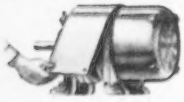
ASBESTOS-PROTECTED WINDINGS

Asbestos-protected windings withstand high temperatures and guard against carbonization. Each wire is insulated and isolated with asbestos, to protect against burn-outs & increase motor life.

SPLIT HUB FAN

The propulsion fan forces an air blast against lamination edges, dissipating the heat as fast as it generates—keeping the motor continuously cool. The air is drawn in through end grill.

REMOVABLE COVER

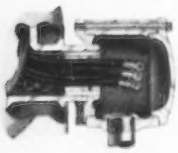


The cover plate can be quickly removed by loosening screws for inspection and to eliminate deposits of dust, dirt, lint, oil and all other accumulations.

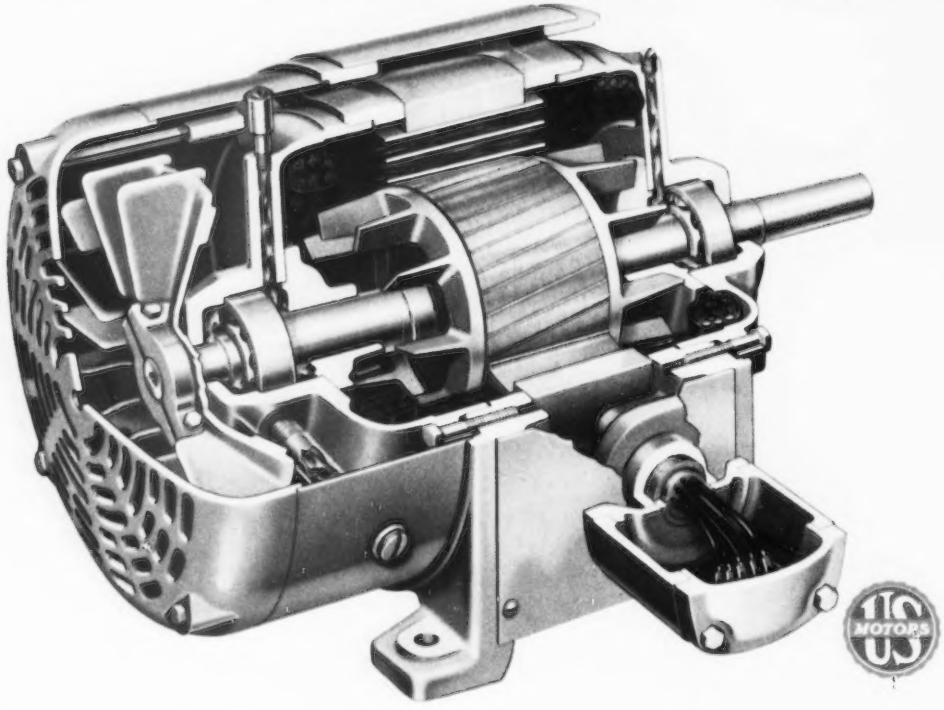
CENTRICAST ROTOR

Centrifugally cast from molten aluminum into a solid, indestructible structure, free of defects.

SEALED TERMINAL



Extra large chamber is sealed with special compound, very high in dielectric strength and with a high melting point.



SMOOTH GRILLE

For protection of the fan and to prevent entrance of debris, an end grille is provided; smoothly contoured.

CERTIFIED SAFE FOR HAZARDOUS SERVICES

U. S. Totally-Enclosed Motors carry the official Underwriters' label for explosion-proof services in Class I, Group D, for highly inflammable gases and volatile liquids, and Class II, Groups F and G for combustible dusts. These motors are also available for non-explosion-proof services such as chemicals, dust and moisture, without label, and with or without fan —Horizontal, Vertical and Varidrive types. New Bulletin gives full details.

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Send your new Bulletin illustrating and describing U. S. Totally-Enclosed Motors. ☐ Also General Bulletin of all U. S. Motors. ☐

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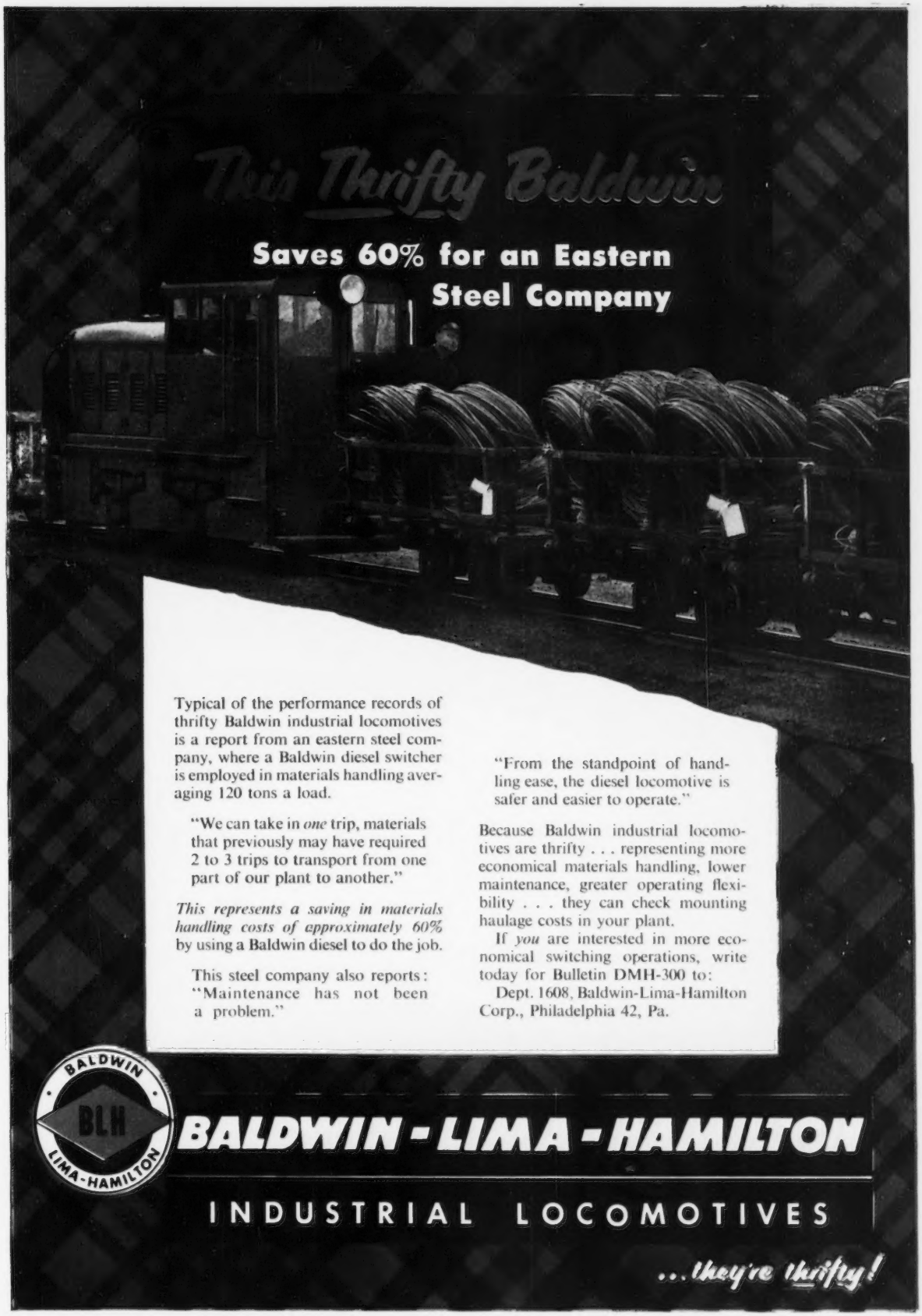

Typical of the performance records of thrifty Baldwin industrial locomotives is a report from an eastern steel company, where a Baldwin diesel switcher is employed in materials handling averaging 120 tons a load.

"We can take in *one* trip, materials that previously may have required 2 to 3 trips to transport from one part of our plant to another."

This represents a saving in materials handling costs of approximately 60% by using a Baldwin diesel to do the job.

This steel company also reports: "Maintenance has not been a problem."

"From the standpoint of handling ease, the diesel locomotive is safer and easier to operate."

Because Baldwin industrial locomotives are thrifty . . . representing more economical materials handling, lower maintenance, greater operating flexibility . . . they can check mounting haulage costs in your plant.

If *you* are interested in more economical switching operations, write today for Bulletin DMH-300 to:

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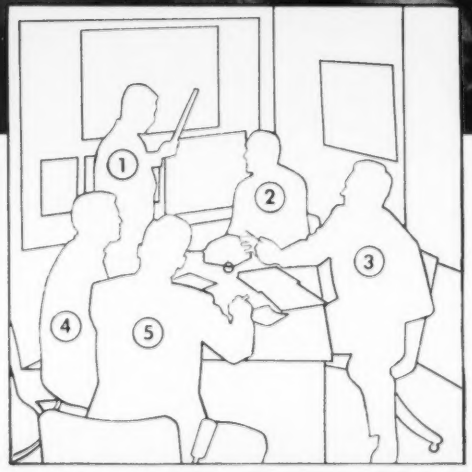
INDUSTRIAL LOCOMOTIVES

. . . they're thrifty!



1. Westinghouse Application Engineer
2. Westinghouse Sales Engineer
3. Chief Engineer
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5. Production Superintendent

Your motor and control problems are local . . . so is Westinghouse application assistance

Do you put a full team on the field when you tackle a motor and control application problem? Are you cashing in on the know-how of your local staff of Westinghouse application engineers? Take a look at this line-up:

Your local Westinghouse sales engineer has a broad knowledge of all Westinghouse Motors and Controls. He knows their capabilities and limitations. He knows how to match motors and controls for maximum production.

Your local Westinghouse application engineer is equipped to analyze any motor and control problem and then develop the best solution. He can handle any application problem from a simple machine tool to a complete production line.

Your local Westinghouse product engineer is a specialist in one type of motor or control. These men work at the local level but operate from a manufacturing headquarters office.

Enlist the services of these men on your next motor and control application job. Call your local Westinghouse office for further details, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21746

Application engineers work out of 126 Westinghouse offices

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EIMCO LOADERS ARE MADE ONLY BY EIMCO

A standard Model 21 Eimco Loader, sturdy, dependable and easy to operate.

The Eimco 21 is a favorite in many foreign countries. Here it is in South America.

An economical loader, the 21 is used in pairs in wide headings or (below) as the loader where a world's record of 111 feet was driven in 24 hours.

The best loaders are made only by EIMCO. There can be no substitute for the experience gained thru invention, service, development and specialization in one particular field and the loading busines is a specialized field with EIMCO.

EIMCO, as the originator of the successful method of loading underground has made many changes in the design of the loader and have tried and tested practically every other method, adopting only the ideas that will give better loading and better customer service.

On customer comparison of all equipment offered and many others that will be offered in the future, EIMCO remains the top favorite of all buyers. There is nothing that can compare with it in quality, workmanship or operation. EIMCOS have consistently won every competitive test, have set and reset new world's mucking records, have been used by contractors on practically all high speed tunnels, and are standard equipment with all large mining companies.

When you have a loading job — select the product of the firm that specializes in loading — get an EIMCO.

EIMCO AH75

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BETTER LOADING

"The job called for more tonnage than we'd ever moved before so we picked the EIMCO 104 and it did everything you said . . ." Yes! when you need fast efficient loading you can't beat an EIMCO. In rock, clay, sand, gravel or any combination of these materials the 104 will dig and load between 350 and 450 tons per hour — given sufficient haulage equipment.

The EIMCO does not have to turn to discharge. This feature saves wear and tear on tracks and rollers; saves time in loading, makes possible loading in narrow cuts and road cleanup jobs without interfering with traffic.

EIMCO's are easier on trucks too — you can control the bucket anywhere in its travel — stop it, hold it, "dribble" the load into small trucks.

For small jobs there are other EIMCO models, seven sizes to choose from to fit every size loading job. When you want loading equipment get an EIMCO — write for information on the machine for your job now.

EIMCO A476

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The World's Largest Manufacturers of Underground Rock Loading Machines

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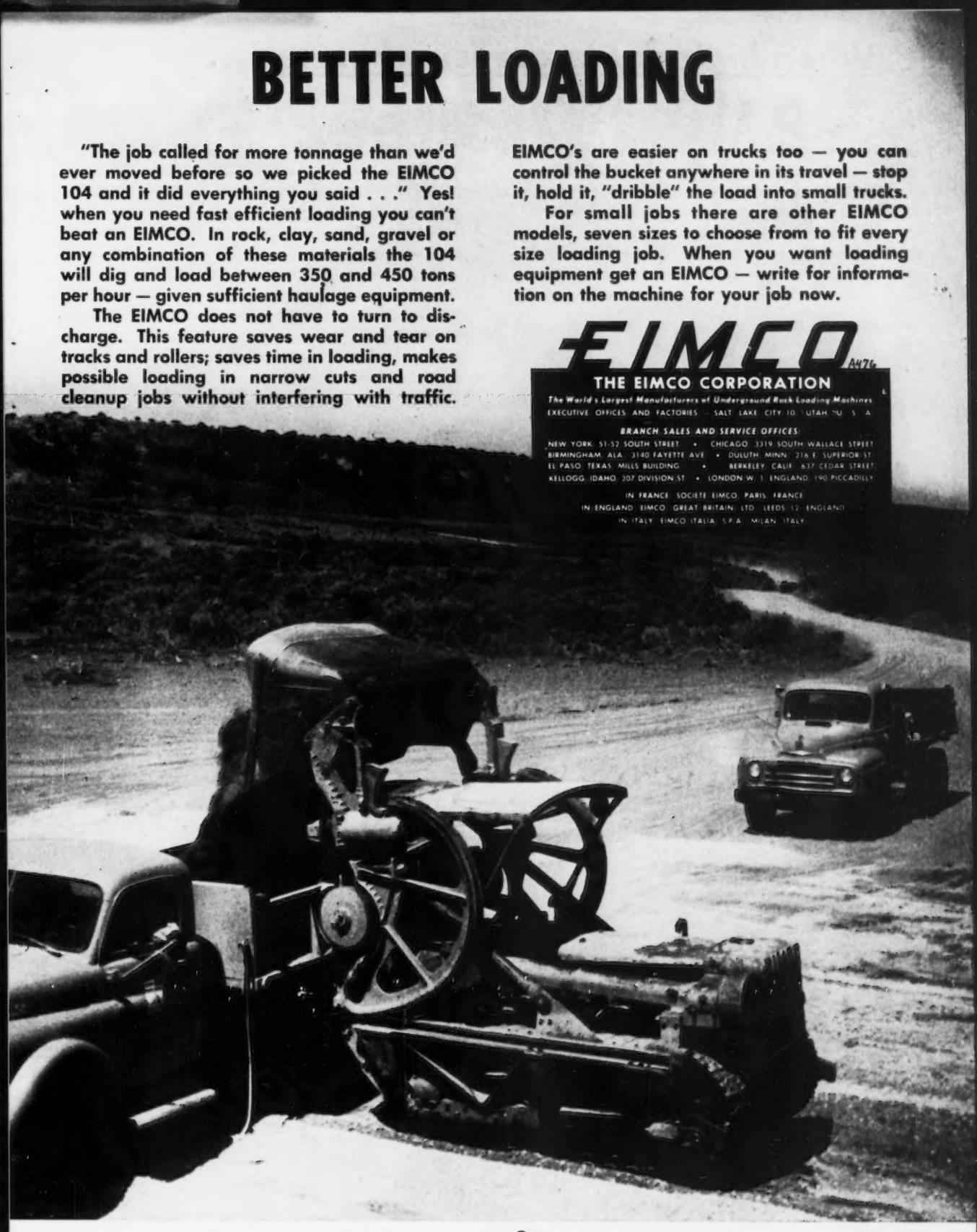
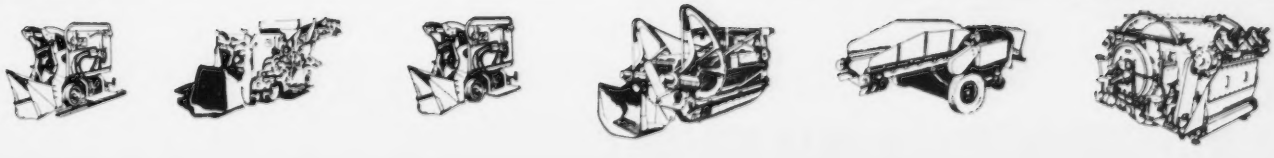
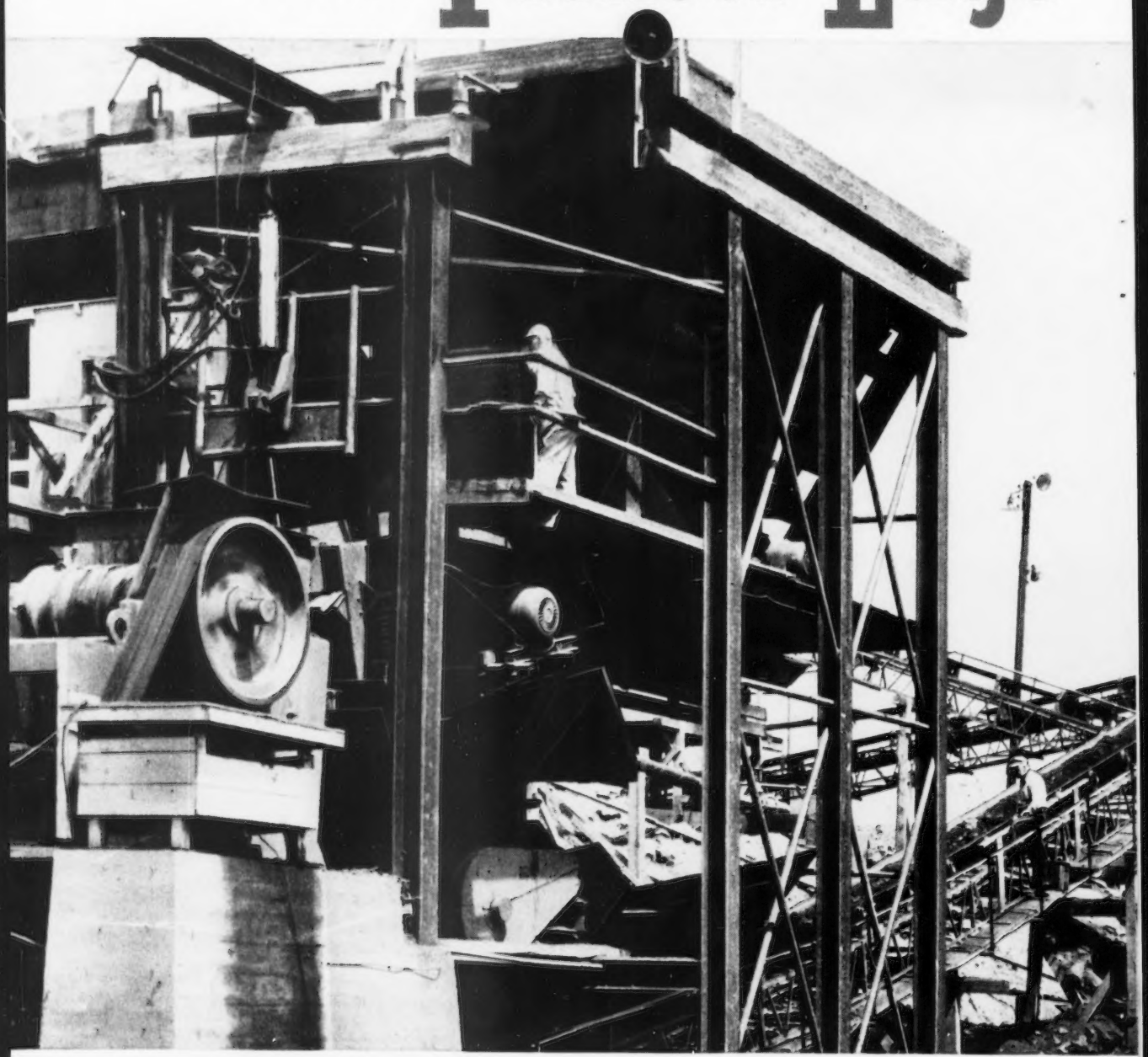




When high grade ore is exhausted...

that Pioneer Edge



BUY BOTH!
HIGHER OUTPUT
LOWER UPKEEP

Pioneer

Continuflo EQUIPMENT

helps old mines pay off

Coons installs all-Pioneer plant at Genoa

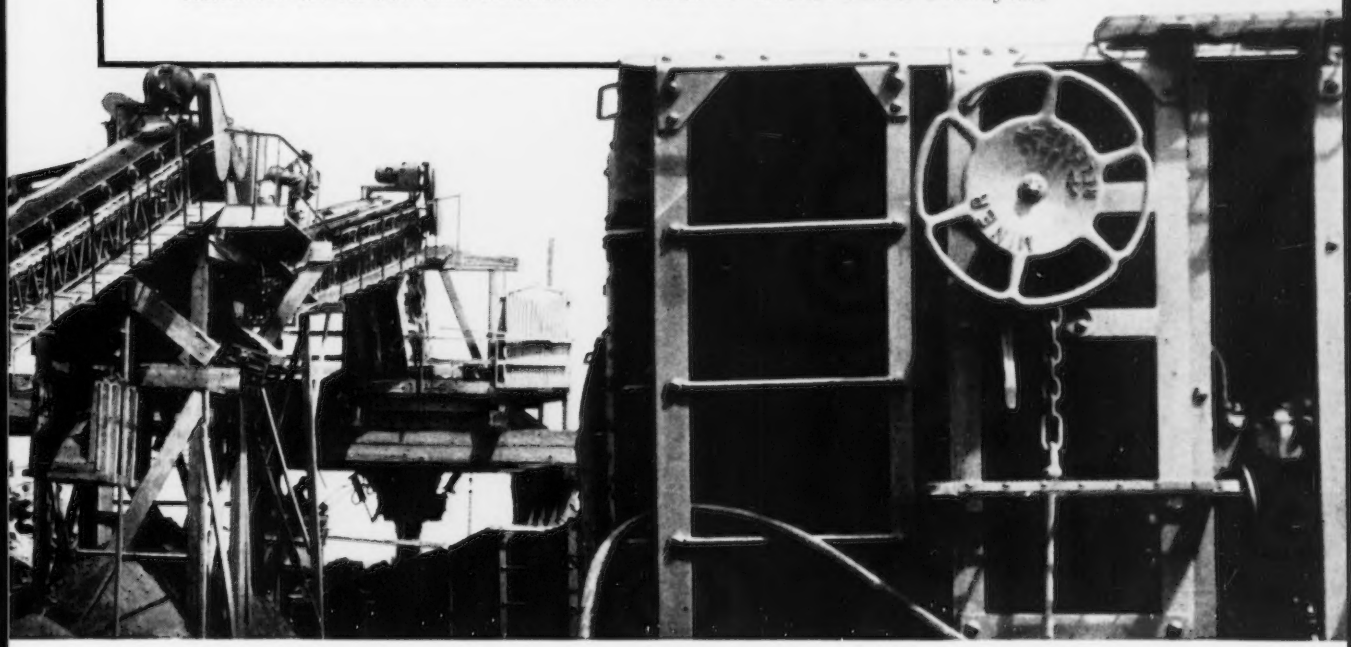
Here's another old mine brought back to life because modern, low-cost production methods have made it possible.

The Genoa mine, near Eveleth, Minnesota, was abandoned as an underground mine many years ago. But today, as an open pit, it's humming again, doing its part to relieve the nation's steel shortage.

To make sure this new operation would pay off, the E. W. Coons Company realized it must build a beneficiation plant that would produce large tonnages at lowest possible cost. This called for an all-PIONEER installation to handle the initial crushing, screening and washing.

The reopening at Genoa adds another to the long list of PIONEER successes ... another instance in which the famous PIONEER EDGE has helped prolong the life of an existing mine or bring an old one back into profitable production.

Crushing and screening equipment at Genoa consists of a 48″ x 12′3″ PIONEER-ORO Manganese Steel Feeder, a 5′ x 12′ PIONEER Mesabi Scalping Screen, a 30 x 42 PIONEER Jaw Crusher, a 5′ x 12′ PIONEER Double Deck Washing Screen, and several lengths of PIONEER 30″ Lattice Frame Conveyors.



Worried about production costs?

● Wherever you operate, you'll profit by installing equipment that will boost production at the same time it's lowering upkeep costs. That's why it will pay you to *check with PIONEER.*

Want details? Just write or mail the coupon ... today.

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1515 Central Avenue • Minneapolis 13, Minnesota
(SUBSIDIARY OF POOR & COMPANY • CHICAGO)

● Please send me information on the equipment checked.

☐ JAW CRUSHERS	☐ GRAVEL PLANTS	☐ APRON FEEDERS
☐ ROLL CRUSHERS	☐ WASHING PLANTS	☐ MECHANICAL FEEDERS
☐ ROCK PLANTS	☐ BITUMINOUS PLANTS	☐ VIBRATING SCREENS
☐ ORO FEEDERS	☐ BITUMINOUS PAVERS	☐ CONTINUFLO CONVEYORS

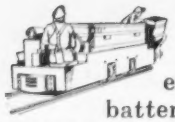
Name _____

Company _____

Address _____

City _____ *Zone* ____ *State* _____

INSIDE AN EXIDE-IRONCLAD



Inside . . . where it counts most . . . EXIDE-IRONCLAD is entirely different than any other battery. It's made that way by EXIDE'S exclusive IRONCLAD slotted-tube construction . . . a principle that provides direct operating-hour savings for you.

OF *ALL* BATTERIES, ONLY EXIDE-IRONCLADS HAVE POWER TUBE POSITIVES

The positive plate is different . . . unique . . . exclusive. It is the most effective retainer of active material yet demonstrated in heavy duty service. Slotted tubes contain the active material. So fine are the slots that, while permitting easy access of electrolyte, they retard the active material from washing out, hold it during repeated cycles of charge-discharge, and the vibration of rough use.

Today's battery-powered equipment is being used harder than ever before. Unless the batteries have internal shock protection they tend to deteriorate under hard usage—both electrical and mechanical. Only Exide-Ironclad has the plus-protection of the tubular positive that can withstand today's more exacting and rigorous heavy-duty battery services.

Your EXIDE sales engineer will give you the factual inside story. See for yourself why *only* an EXIDE-IRONCLAD gives maximum day-after-day service under the most difficult operating conditions . . . *with a minimum of maintenance expense.*

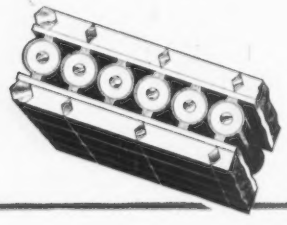
THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto

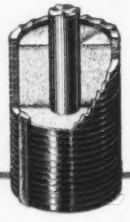
1888 . . . DEPENDABLE BATTERIES FOR 65 YEARS . . . 1953

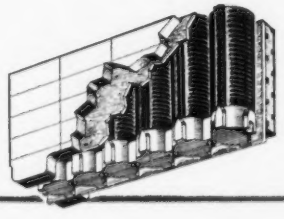
Cross section shows relation of positive plate to separators and negative plate. Note the much greater exposure of active material to electrolyte as compared with that of the usual flat positive plate. This greater exposure makes possible the high power ability and uniform-voltage characteristics of the Exide-Ironclad. The negative plates have been made extra heavy to balance the increased capacity of the power tube positives.

Running through center of each tube is an alloy core which is cast with the heavy top cross bar. These form the sturdy, non-buckling grid. Both core and top bar are made of Exide's new corrosion-resistant Silvium, an alloy of silver, lead and other components, which adds greatly to plate's long life.

New polyethylene insulating tube sealer of acid-proof, non-corroding plastic fits snugly into bottom of slotted tubes and further reduces loss of active material. Thus more active material remains available, and the high battery capacity is maintained for a longer working life.







Exide-Ironclad

YOUR BEST POWER BUY . . . AT ANY PRICE

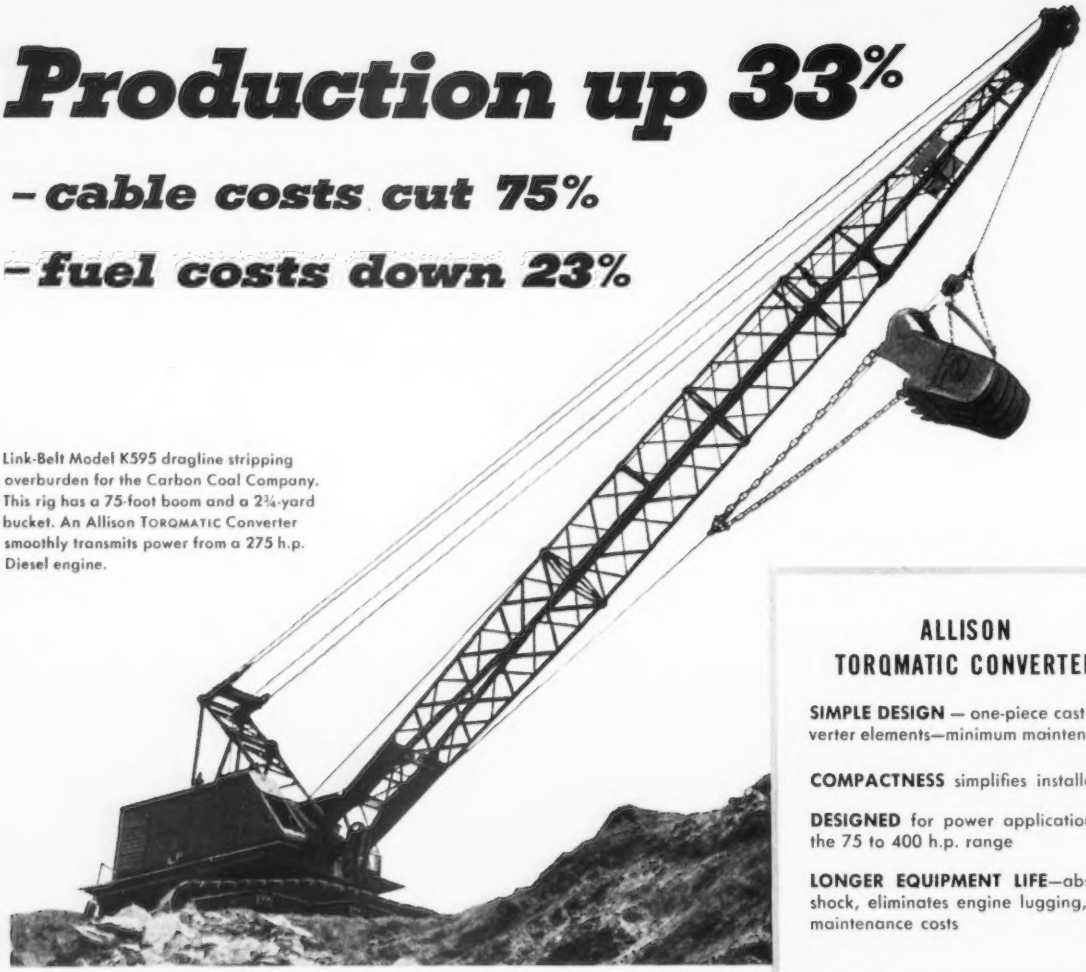
"Exide-Ironclad" and "Silvium" *Reg. T.M. U.S. Pat. Off.*

You'll Find The Difference

Production up 33%

-cable costs cut 75%

-fuel costs down 23%



Link-Belt Model K595 dragline stripping overburden for the Carbon Coal Company. This rig has a 75-foot boom and a 2¾-yard bucket. An Allison TORQMATIC Converter smoothly transmits power from a 275 h.p. Diesel engine.

ALLISON TORQMATIC CONVERTER

SIMPLE DESIGN — one-piece cast converter elements—minimum maintenance

COMPACTNESS simplifies installation

DESIGNED for power applications in the 75 to 400 h.p. range

LONGER EQUIPMENT LIFE—absorbs shock, eliminates engine lugging, cuts maintenance costs

Here's another operator who's boosting production and cutting costs with Allison TORQMATIC DRIVES: The Carbon Coal Company operates two Link-Belt draglines, strip-mining coal near Grove City, Pa. The units are nearly identical—one has an Allison TORQMATIC Converter, the other is direct-driven—but there's a big difference in operating costs and production.

The Allison Converter absorbs shock loads so dragline cable on the TORQMATIC-equipped unit lasts four times as long, *saving $2160 a year on cable alone*, a reduction of 75%.

The TORQMATIC-equipped unit strips a 60x40x25 foot "lift" of overburden in 24 hours against 32 hours for the direct-driven unit, a 33% increase in production. A comparison of daily fuel records shows the friction drive unit consumes 130 gallons while the Converter-equipped unit uses only 100 gallons, a cut in fuel costs of 23%.

The TORQMATIC-equipped unit has rolled up such an impressive performance record that this operator intends to specify TORQMATIC DRIVES in all his new heavy-duty equipment. You, too, can cut your costs by specifying Allison TORQMATIC DRIVES the next time you buy. Ask your equipment dealer, manufacturer or write:

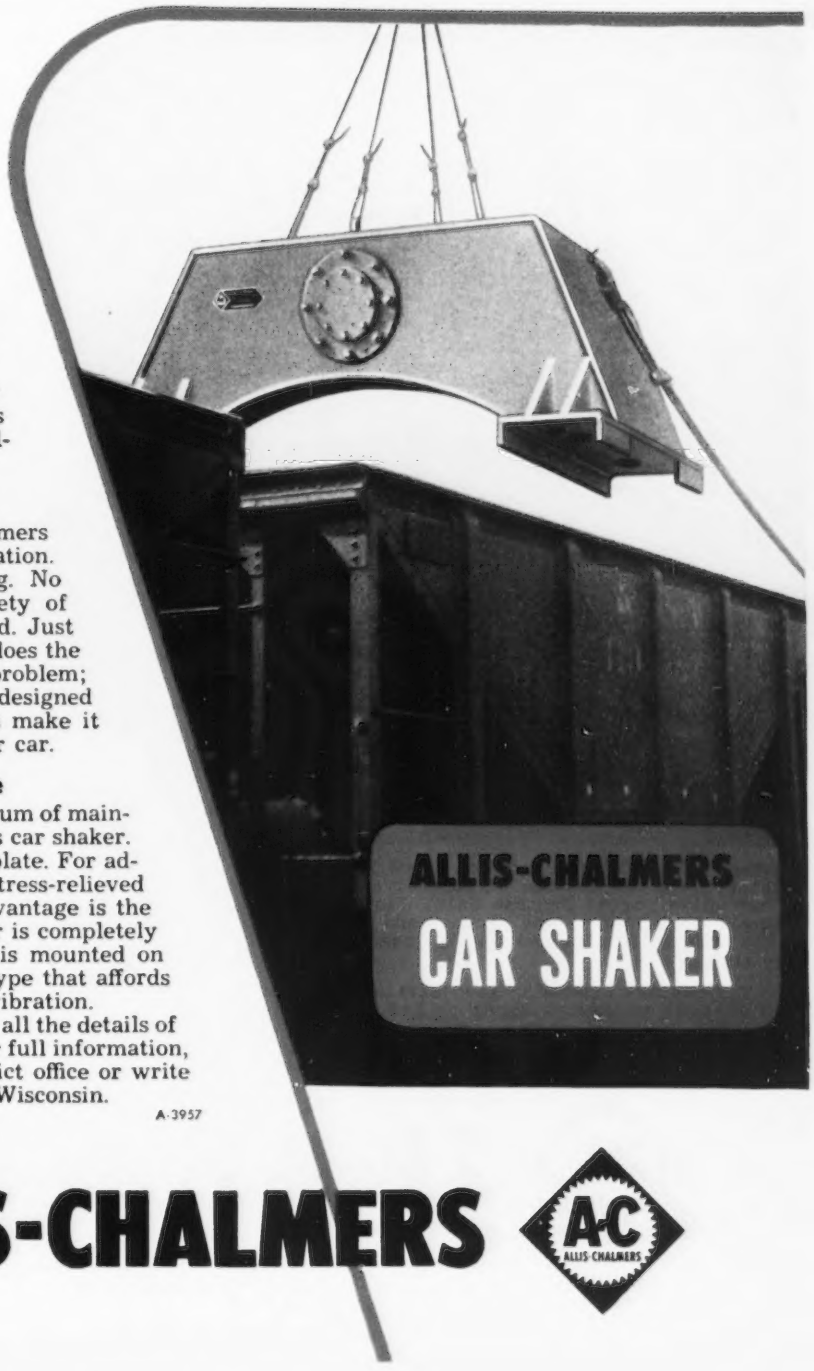
ALLISON DIVISION OF GENERAL MOTORS
Box 894MM, Indianapolis 6, Indiana

Allison **TORQMATIC DRIVES**

GM GENERAL MOTORS

COMPACT, EFFICIENT HYDRAULIC DRIVES FOR CRANES * TRUCKS * TRACTORS * SCRAPERS * SHOVELS * DRILLING RIGS

CUT UNLOADING COSTS



You can save time and money using Allis-Chalmers car shakers for unloading cars. Here are two examples: **(1)** You can unload cars of wet sand or like materials in 1½ to 2¼ minutes; **(2)** you can unload coal in 1 to 6 minutes, depending on surface moisture.

In fact, you can unload any material in minutes, even if it is damp, compacted or in a partially frozen condition.

One-Man Operation

Best of all, using an Allis-Chalmers car shaker is a one-man operation. No more pounding or digging. No more worrying about the safety of men inside cars being unloaded. Just press a button; the car shaker does the rest. There is no positioning problem; Allis-Chalmers car shakers are designed to hang level, and wide shoes make it easy to engage any size hopper car.

Low Maintenance

You'll get long life and a minimum of maintenance with an Allis-Chalmers car shaker. Sides and top are heavy steel plate. For additional strength, the body is stress-relieved after welding. Another big advantage is the power arrangement. The motor is completely enclosed in the body. And it is mounted on rubber shear mountings of a type that affords maximum protection against vibration.

It will pay you to investigate all the details of Allis-Chalmers car shakers. For full information, consult your nearby A-C district office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3957

ALLIS-CHALMERS

STANDARD ENGINEER'S REPORT

DATA

LUBRICANT Calol Vistac Oil

UNIT Rock drill-Ingersoll-Rand drifter

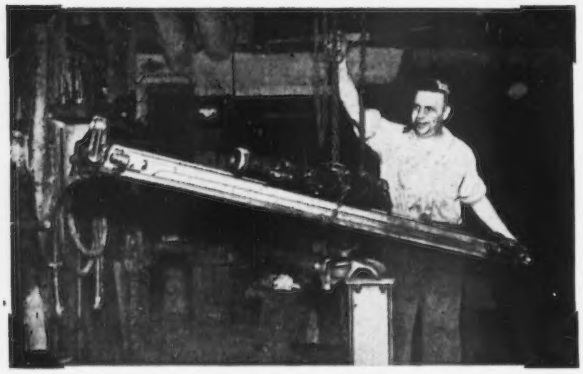
LUBRICATOR Line oiler

OPERATION Deep underground mining

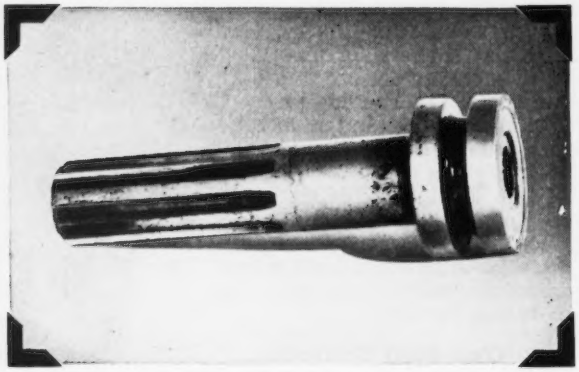
CONDITIONS High humidity & temp.

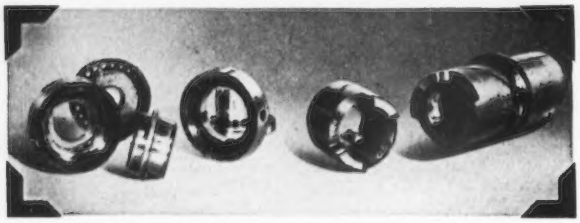
FIRM Sunshine Mining Co., Kellogg, Idaho

Only 0.001 wear on rock-drill piston in 120 shifts!



ON THE 3100-FOOT LEVEL of the famous Sunshine silver mine, this drifter, lubricated with Calol Vistac Oil, was in steady service for more than two months before coming in for service. When disassembled by "Drill Doctor" Dave Farnsworth, the piston "miked" only 0.001 inch wear despite the tough conditions in which the drill works. Working face is 400 feet below sea-level. Humidity is around 90 with atmosphere at a constant 75°F. After cleaning, the piston and other parts were put back in service.

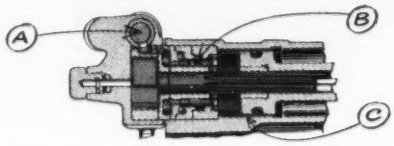




VALVE-CHEST ASSEMBLY, chuck and chuck jaw from the drifter. Note the absence of lacquer or corrosion on air-valve parts. Because Calol Vistac Oil has held air-tool wear to the minimum and is approved by the miners, Sunshine Mining Co. has used it for more than 10 years.

REMARKS: Besides providing good air-tool lubrication without excessive vapor or bad odor, Calol Vistac Oil is excellent for heavy-duty plain bearings, reduction gears, motor gear heads, etc. It comes in several grades and may be applied by wick-, ring-, and drip-feed oilers.

How CALOL Vistac Oil cuts costs in air-tool equipment



A. Atomizes quickly and completely—carries evenly over all parts. Does not fog excessively and has no unpleasant odor.

B. Additives help form tenacious, oily, pressure-resistant film in wet or dry conditions—cuts wear and power loss. Small quantity lubricates efficiently.

C. Resists high temperatures and oxidation. Stays fluid at low temperatures.

FREE CATALOG: "How to Save Money on Equipment Operation," a new booklet full of valuable information, will be sent you on request to Standard Oil Company of California, 225 Bush St., San Francisco, Calif.

CALOL

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

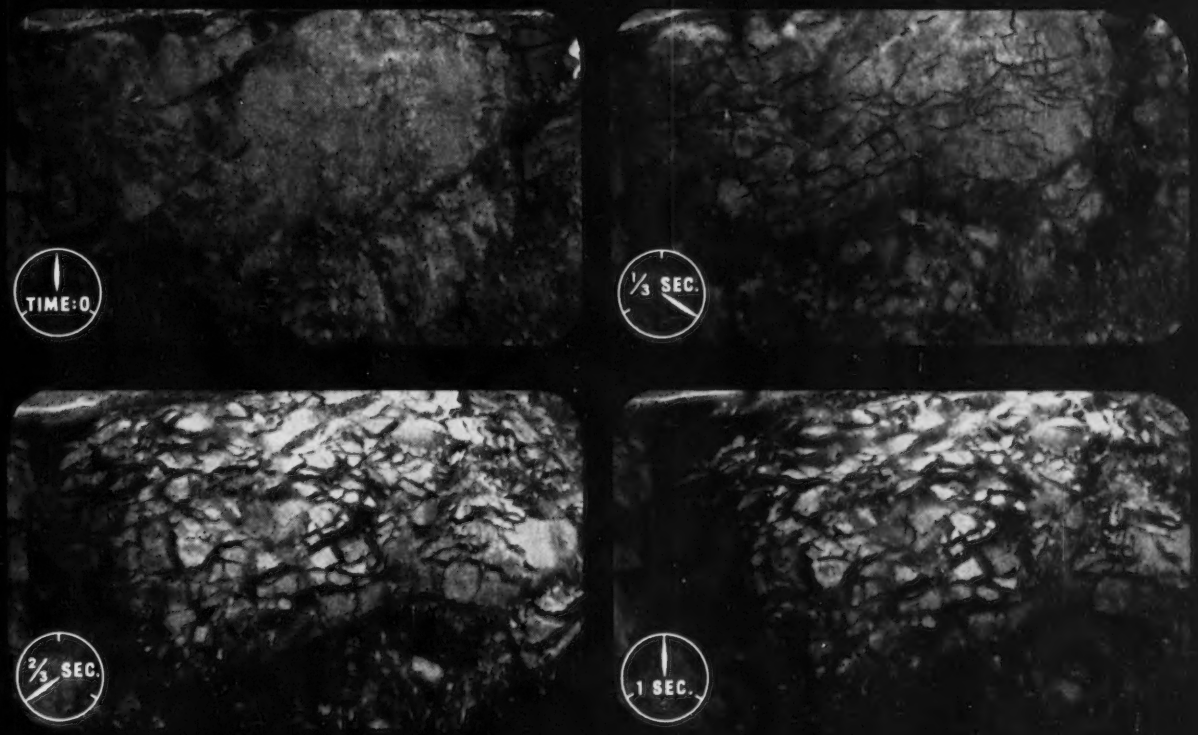
TRADEMARK "CALOL" REG. U.S. PAT. OFF.

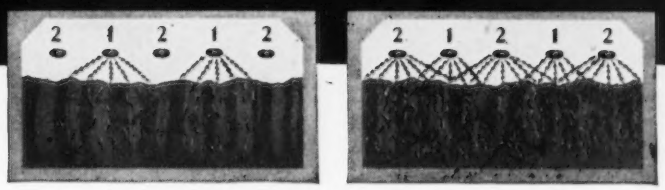
STANDARD OIL COMPANY OF CALIFORNIA
225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY
P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS
P. O. Box 862 • El Paso, Texas

Here's how ROCKMASTER® gives better breakage





The first delays put the rock under stress. Then the number two punch of the second delays cuts across the lines of force at points of maximum stress giving maximum breakage.

THIS unusual sequence of photos shows explosives force, first swelling and then bursting a solid face of granite. It is visual evidence of the excellent breakage possible with the ROCKMASTER blasting system used in an alternate pattern.

Theory behind the breaking action of this pattern is that the first delays, detonating within definite limits of controlled timing, place the entire burden under stress. Then at the moment of maximum tension the second delays, also firing with controlled timing, throw the second punch which produces a wedging and bursting action throughout the burden. The explosives gases of alternate ROCKMASTER blasting can be kept under prolonged confinement, reducing both air blast and ground vibration to a minimum.

Alternate action cannot be duplicated by progressive milli-second delay firing methods or by any form of top detonation.

If you want to see how others have profited by using ROCKMASTER milli-second delay detonators with the ROCKMASTER system of explosives choice and loading methods, send for your free copy of the 20-page book on the ROCKMASTER "16" Blasting System.

ATLAS

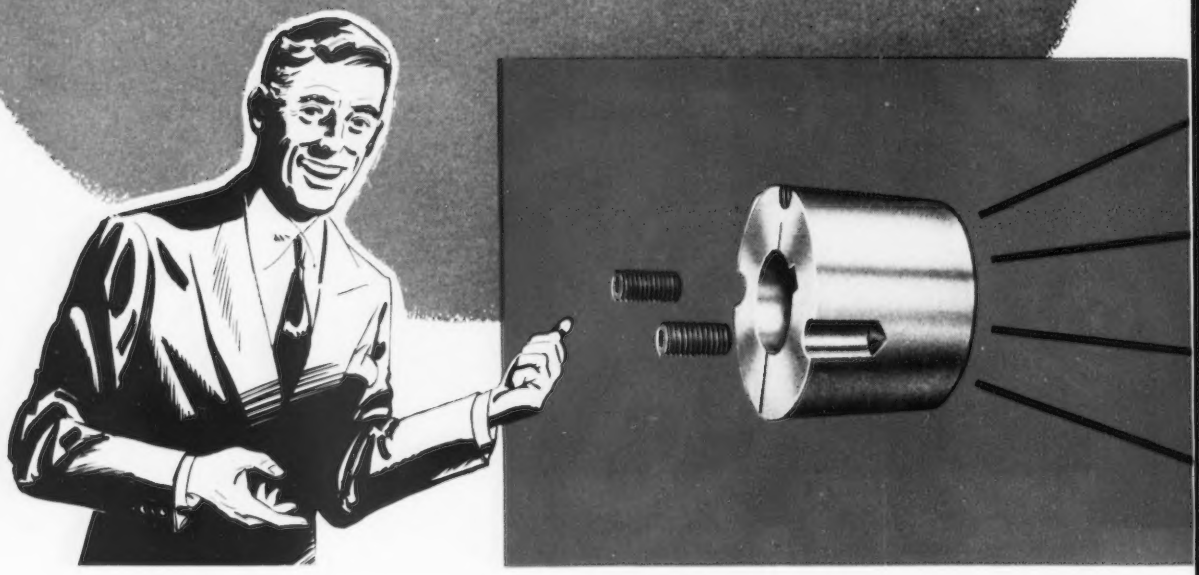
ATLAS EXPLOSIVES

"Everything for Blasting"

ATLAS POWDER COMPANY, WILMINGTON 99, DELAWARE

Offices in principal cities

Now-Standardize on TAPER-LOCK



Now, for the first time, you can have all the benefits of standardizing on a truly modern method of mounting wheels on shafts . . . through the famous Dodge patented Taper-Lock design.

The time-saving, cost-cutting performance of Dodge Taper-Lock . . . already proved in millions of installations of Taper-Lock Sheaves, Couplings and Conveyor Pulleys . . . is now available in a complete line of Taper-Lock Sprockets with Dodge Roller Chain.

The bushing pictured here fits into the hub of every one of the Dodge products shown—sprockets, sheaves, couplings, conveyor pulleys. Both tapered bushings and hubs are precision machined to achieve perfect interchangeability. The result is less down-time on machines, simpler maintenance, reduced inventories. Taper-Lock gives you an unmatched opportunity to lower your costs and keep production rolling.

Dodge Taper-Lock grips the shaft for the full length of the bushing—holds with the firmness of a shrunk-on fit, yet comes off easily, quickly.

Taper-Lock's exclusive advantages were never more strikingly proved than in the new line of sprockets recently introduced by Dodge. For Taper-Lock brings to sprockets a new "off-the-shelf" availability. No time-consuming and costly reboring, key seating, drilling and tapping for set screws, needed to fit them to the shaft! Dodge Taper-Lock is available in both driver and driven sprockets from No. 40 to No. 100, up to 112 teeth. Taper-Lock bushings to fit shafts from ½″ to 10″ are available from stock.

Consider carefully the cost-saving advantages you get by standardizing on Taper-Lock — the modern method of mounting wheels on shafts. For further information, call your Dodge Distributor, or write the factory.

DODGE MANUFACTURING CORPORATION, 3100 Union Street, Mishawaka, Indiana

TAPER-LOCK SPROCKETS and Dodge Quality Roller Chain

—THE MODERN WAY TO MOUNT SPROCKETS

—THE MODERN WAY TO MOUNT SHEAVES

TAPER-LOCK SHEAVES

—THE MODERN WAY TO MOUNT COUPLINGS

TAPER-LOCK COUPLINGS Rigid and Flexible

—THE MODERN WAY TO MOUNT CONVEYOR PULLEYS

TAPER-LOCK SOLID-STEEL CONVEYOR PULLEYS

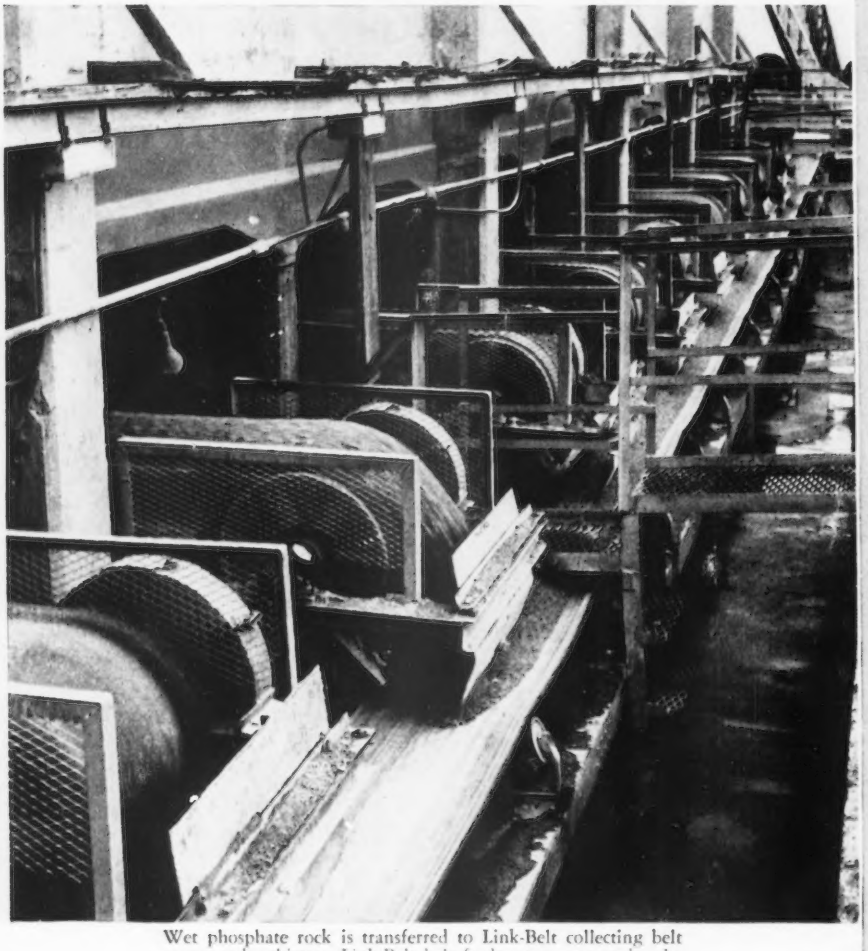
CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified phone book.

DODGE

of Mishawaka, Ind.

TOTAL ENGINEERING

It's one reason why LINK-BELT gives you better belt conveyors



Wet phosphate rock is transferred to Link-Belt collecting belt conveyor by thirteen Link-Belt belt feeder-conveyors under the storage bins. Eleven of the feeder-conveyors are reversible.

WHETHER your handling requirements are simple or complex, you'll find the right answer at Link-Belt. For Link-Belt Belt Conveyors are "totally-engineered." That means every component is matched to the exact needs of the job. And the Link-Belt engineering organization will follow through from start to finish—in the designing, manufacture and erection of all your conveying equipment.

Get all the facts from the Link-Belt office near you. Link-Belt engineers—working with you and your own staff—will help you get the finest in belt conveyors.

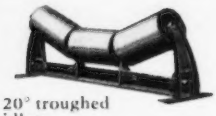
LINK-BELT

BELT CONVEYOR EQUIPMENT

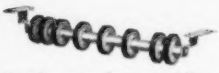
LINK-BELT builds a complete line of belt conveyor components

•

ALL TYPES OF ROLLER BEARING IDLERS

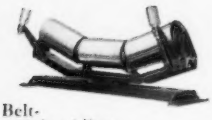


20° troughed idler



Rubber tread return idler

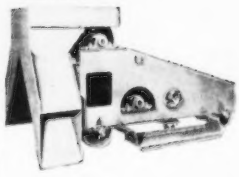
Return idler



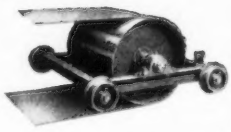
Belt-training idler

Flat-roll idler

BELT AND MOTOR PROPELLED TRIPPERS



COMPLETE DRIVES AND TERMINAL MACHINERY



LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices in Principal Cities. 13,298-A

LIMA

Wheel or truck mounting is available on machines of ¾ and 1½ yards capacity.

THE ALL PURPOSE MACHINE

Here are four typical examples of the versatility of the LIMA Type 604. Realizing that most contractors bid various types of work, LIMA has gone to great lengths to make a machine that is easily converted in the field to shovel, crane, dragline or pullshovel, thus giving the owner the advantage of four machines in one.

Versatility is but one of the many advantages that make the Type 604 a leader in its class. For instance, air controlled clutches do all the work—with one slight touch of the levers, the hoist, crowd, travel and swing clutches can be engaged or disengaged, making for ease of operation. Anti-friction bearings in the drums and other important bearing points reduce destructive friction and lessens lubrication problems. Simplicity of design results in fewer working parts and greater safety for the operator.

For further information on the Type 604, write your nearest LIMA distributor or write to Baldwin - Lima - Hamilton Corporation Construction Equipment Division, Lima, Ohio, U. S. A.

CAPACITIES: Shovels ¾ to 6 cu. yds. Cranes to 110 tons. Draglines, variable.

OFFICES IN PRINCIPAL CITIES OF THE WORLD

BALDWIN - LIMA - HAMILTON

SHOVELS • CRANES • DRAGLINES • PULLSHOVELS • TRUCK CRANES
CRUSHING • WASHING AND SCREENING EQUIPMENT

BALDWIN BLH LIMA-HAMILTON

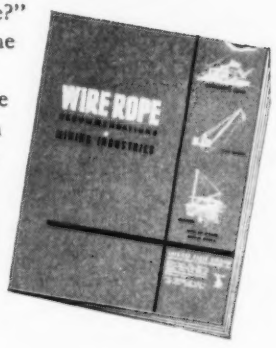
an ACCO product

TRU-LAY Preformed WIRE ROPE

Why Should the Shovel's Hoist Line be Lang Lay?

• Among other reasons, it has more of each wire exposed to wear and will last longer. We might also ask "Why should flattened strand be used for the scraper's cable?" An answer would be—it lasts longer because its relatively flat surface spreads the wear better.

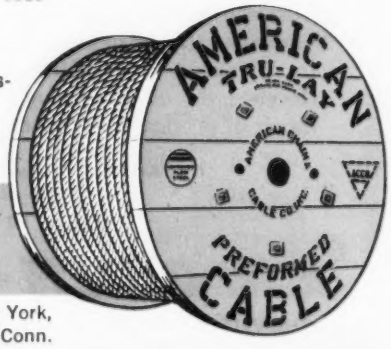
Four different wire ropes are used on the two machines illustrated, three on the shovel and one on the scraper. Each rope is a different construction, and each construction recommended was decided upon by American Cable's engineers after years of careful recording of results of many, many field studies.



This Book Gives Recommendations

Recommendations based on these records are listed clearly in the 12-page "Wire Rope Recommendations for Mining Industries" which shows the best TRU-LAY Preformed construction for the machines you operate. It's full of pictures which makes it easy to find the recommendation you need. Here is a booklet which will help you get longer service—which means lower cost—from every wire rope you use.

See your nearby American Cable distributor who stocks popular TRU-LAY Preformed "Green Strand" Wire Ropes, or write our Wilkes-Barre, Pa., office for your free copy of **DH-128-A** "Wire Rope Recommendations for Mining Industries."



ACCO

TRADE MARK

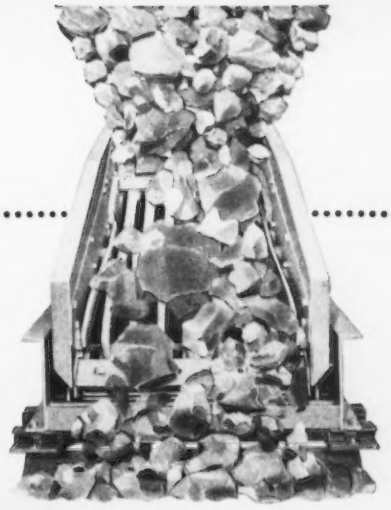
AMERICAN CABLE DIVISION
AMERICAN CHAIN & CABLE

Wilkes-Barre, Pa., Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

SYMONS VIBRATING BAR GRIZZLIES

. . . up to 500 tons per hour handling feeds ranging to power shovel size

The SYMONS Type-K vibrating manganese Bar Grizzly is recommended for large tonnage *Scalping* of ore, rock or gravel. The powerful vibrating action of the Bar Grizzly makes it particularly effective for wet, sticky or gummy materials. The sloping, curved bars of the Symons Bar Grizzly tend to cascade the material as it passes over the screening surface. The tumbling action effectively assists in separating the undersize. Will handle feed sizes up to 30″ and larger.



For full details about the SYMONS BAR GRIZZLY, send for BULLETIN 121A.

FOR HEAVY DUTY SCALPING SERVICE

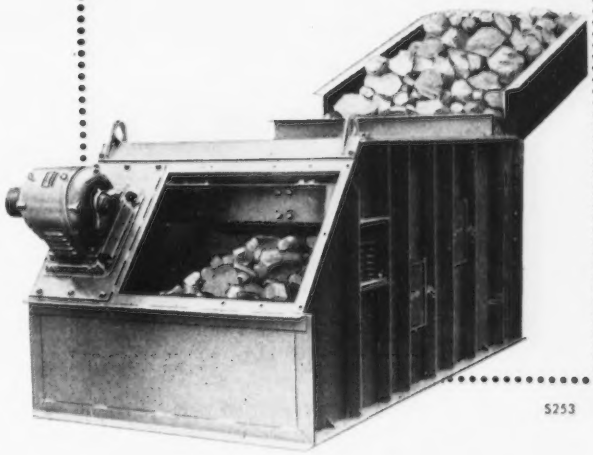
SYMONS VIBRATING ROD GRIZZLIES

. . . up to 500 tons per hour for feeds up to 10″ — 12″

The SYMONS Type-K—RG vibrating Rod Grizzly is built for heavy duty scalping service in large tonnage operations . . . bridging the gap between primary breaking and the secondary crushing and screening operations. It can readily handle dry, wet, sticky or gummy ores and rock. Some of the important features include:

Abrasion resistant heavy spring steel rod screening surface; Long lasting, low cost rods are easily adjusted or replaced; Effective, vigorous vibration provides thorough scalping; Amplitude of vibration can be quickly and easily changed to meet various operating conditions. Ideally suited for service following most sizes of primary crushers and scalping operations requiring relatively coarse separations in the range between 1″ to 4″.

For full details about the SYMONS ROD GRIZZLY, send for BULLETIN 207.



S253

SYMONS . . . A Registered Nordberg Trademark Known Throughout the World

NORDBERG MFG. CO., Milwaukee, Wisconsin

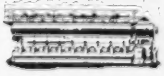
SYMONS GYRATORY CRUSHERS

SYMONS CONE CRUSHERS

MINE HOISTS

SYMONS "V" SCREENS

GRINDING MILLS



DIESEL ENGINES

NORDBERG MACHINERY

NORDBERG

SYMONS SCREENS NORDBERG

MACHINERY FOR PROCESSING ORES and INDUSTRIAL MINERALS

NEW YORK • SAN FRANCISCO • DULUTH • WASHINGTON • TORONTO
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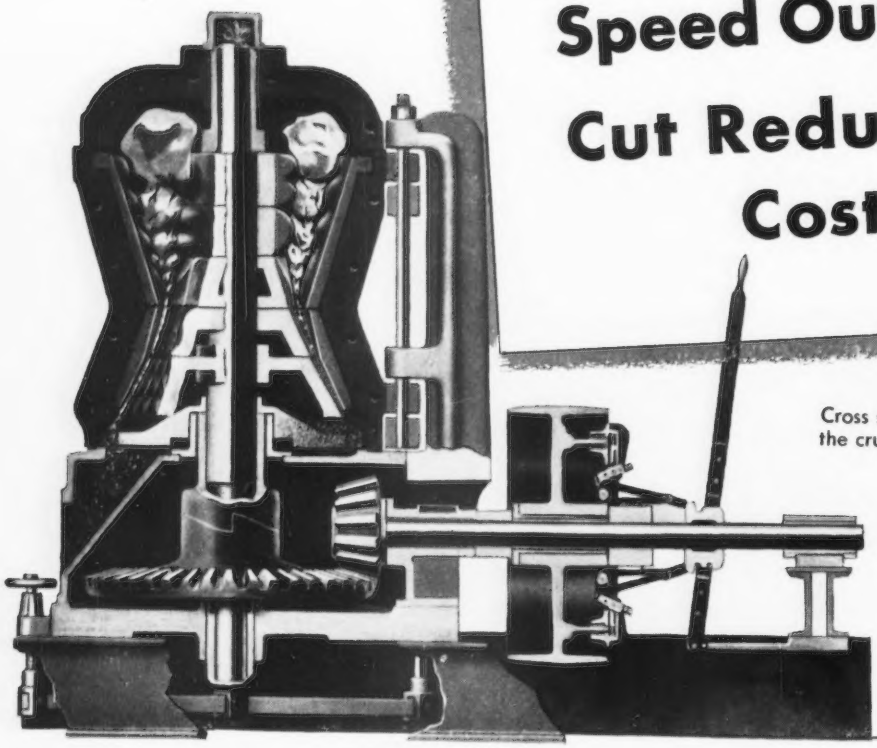
Here's How to Speed Output... Cut Reduction Cost



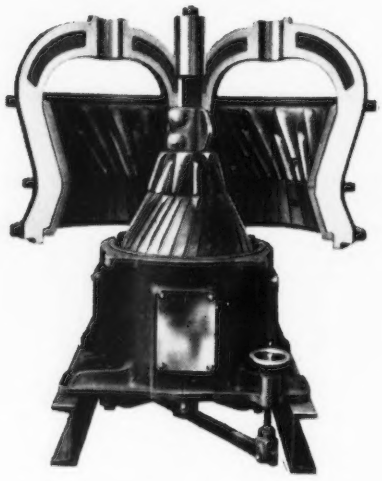
Cross section view illustrating the crushing action.

Use STURTEVANT Rotary Fine CRUSHERS

With the Sturtevant Rotary Fine Crushers you can crush or granulate to even sizes without excess dust. By simply turning the handwheel, the crusher can be quickly regulated to crush down to approximately ¼" and finer, or opened up to produce 1" size of finished product.

"Open-door" accessibility permits fast, easy, thorough cleaning.

Sturtevant Rotary Fine Crushers crush fast... do not clog. Available in output capacities from 1 to 30 tons per hour.



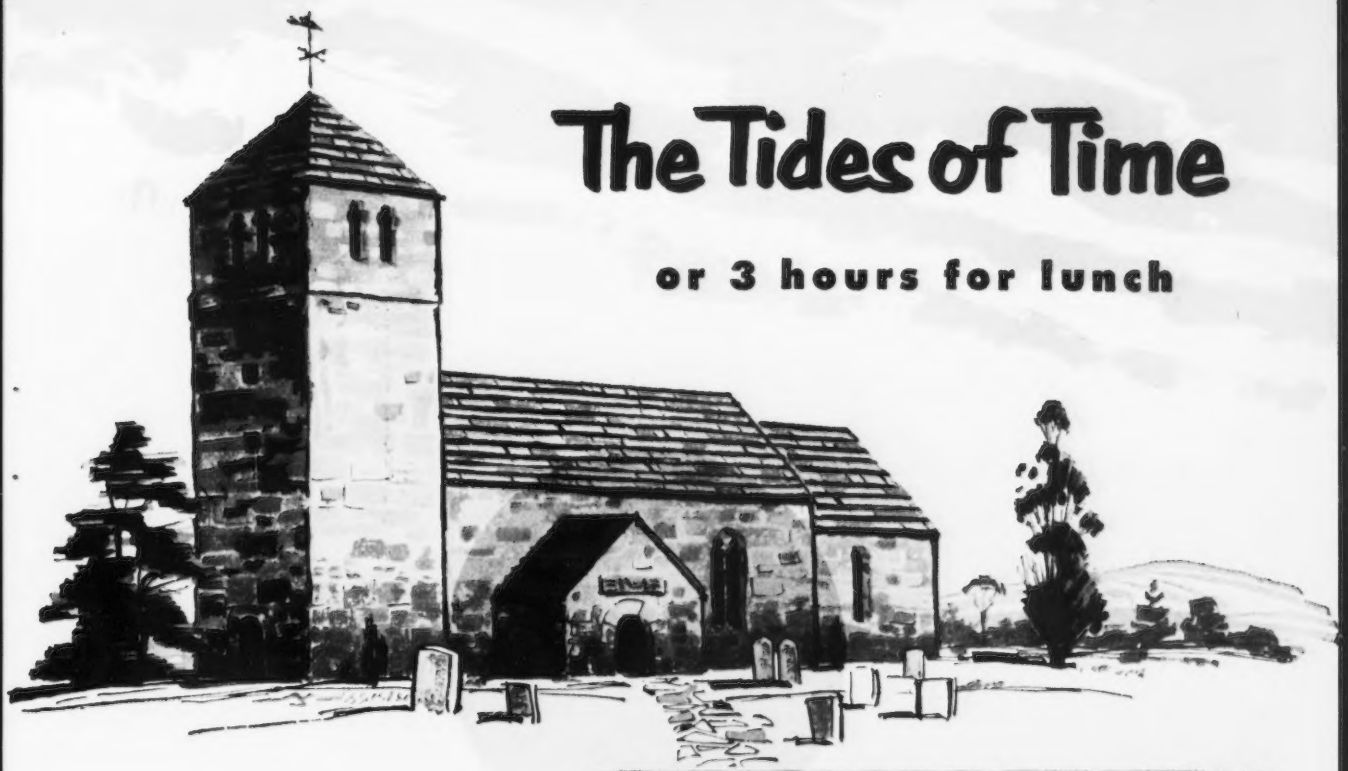
Sturtevant Mill Company

101 CLAYTON STREET, BOSTON 22, MASSACHUSETTS

Designers and Manufacturers of
CRUSHERS • GRINDERS • SEPARATORS
CONVEYORS • MECHANICAL DENS and
EXCAVATORS • ELEVATORS • MIXERS

The Tides of Time

or 3 hours for lunch

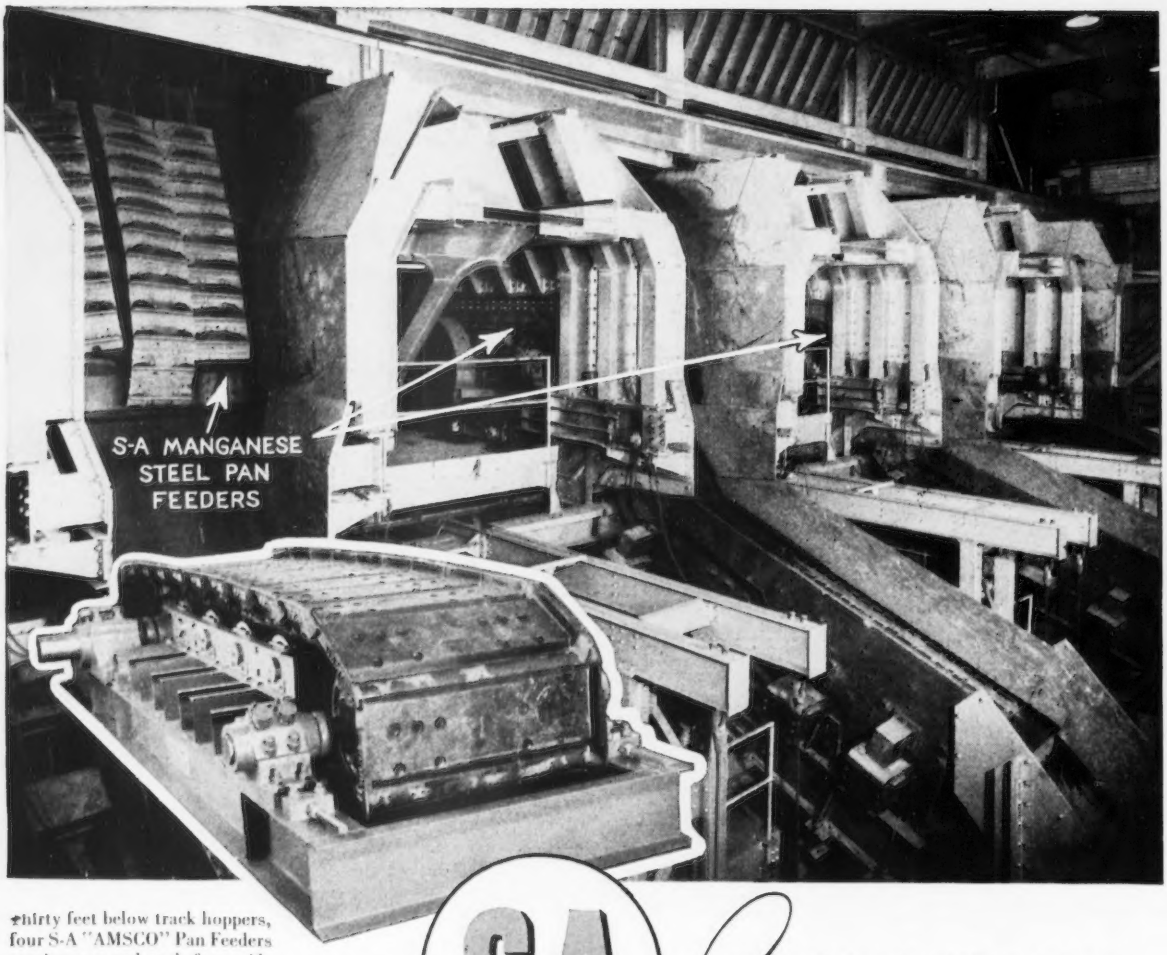


On this sundial on the south wall of a thousand-year-old Saxon church in Yorkshire, the day is divided into eight "Tides" of three hours each. Morgan-tide (morning-tide) is from 4:30 to 7:30 a.m.; Daeg-mael (first-tide is 7:30 to 10:30 a.m., and Mid-daeg (midday or noon-tide) is thoughtfully extended from 10:30 a.m. to 1:30 p.m.—evidently the origin of the three-hours-for-lunch idea. Measuring time in three-hour segments was probably adequate in those days when the most complex machine was the windmill, but today time is so valuable that it is one of the highest priced components in many of our projects. To get the most out of valuable drilling time, we suggest that you use Truco Diamond Bits. Their irresistible cutting power penetrates any formation, swiftly, accurately, thriftily, dependably. They are used profitably in every phase of drilling. May we send you our Diamond Bit Catalog?

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue **Detroit 6, Michigan**

WHEEL TRUEING TOOL CO. OF CANADA, LTD
575 Langlois Avenue Windsor, Ont., Canada



Thirty feet below track hoppers, four S-A "AMSCO" Pan Feeders receive ore and rock from side dump rail cars. Each Feeder is 6 feet wide by 27 feet long. Together they have a capacity of 3000 tons per hour. Still another feeder (not shown) collects ore from the scalping screens.

S-A CONVEYING Systems

for **FEEDING ORE** in high volume . . . at low cost

Belt Conveyors
Belt, Pan & Plate Feeders
Ship Loading Boom Conveyors
Stacking Conveyors
Storage & Reclaiming Systems
"Natural Frequency" Vibrating Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Conveyor Belt Cleaners
Headshaft Holdbacks
Grizzlies & Screens
Centrifugal Pilers
Bin Gates & Tunnel Gates
Car Pullers & Spotters
Bucket Elevators
Skip Hoists
SEALMASTER Ball Bearing Units

• *Write for a bulletin on any of the above*

Feeding huge volumes of heavy, abrasive ore and rock from receiving stations to scalping screens and primary crushing is one of industry's most punishing handling jobs . . . Yet S-A "AMSCO" Manganese Steel Pan Feeders have shown they can withstand and thrive on such crushing impact and abrasive loads . . . thousands of tons a day . . . year after year . . . with a minimum of maintenance.

Almost incredibly rugged, these feeders are another example of S-A engineering to provide continuous heavy duty handling at lowest cost-per-ton . . . Whatever your bulk handling problem, S-A engineers with their complete line of bulk handling equipment units can help you find the right solution for efficient, economical operations.

STEPHEN S-A DAMSON MFG. CO.

4 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

NOW—JOY offers You an Air Leg with All The Best Features—

Design, field test, redesign, test again—this story has been repeated over and over in the development of the Joy air leg. But the result has been worth the effort—because this Joy air leg contains all these features which extensive field use has indicated were necessary for most efficient, most comfortable operation . . .

1 BUILT-IN FEED CONTROL built into the backhead of the drill, giving an infinitely variable range from as little as two pounds to full line pressure without step-by-step graduation.

2 PUSH-BUTTON PRESSURE RELEASE on the control handle for quick retraction. Also permits reduction of pressure when drilling through soft seams without changing setting of feed control.

3 BALANCED FORWARD PRESSURE by attachment of air leg at horizontal center line of drill to minimize misalignment of drill and steel. Results in longer chuck life.

4 LIGHTWEIGHT, easily assembled and dismantled, easy to move around the mine.

5 A PERFECT PARTNER for the powerful, efficient Joy L-47 drill.

You haven't seen efficient drilling and ease of handling until you've tried this perfectly matched pair. Write for complete information. ● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.,*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

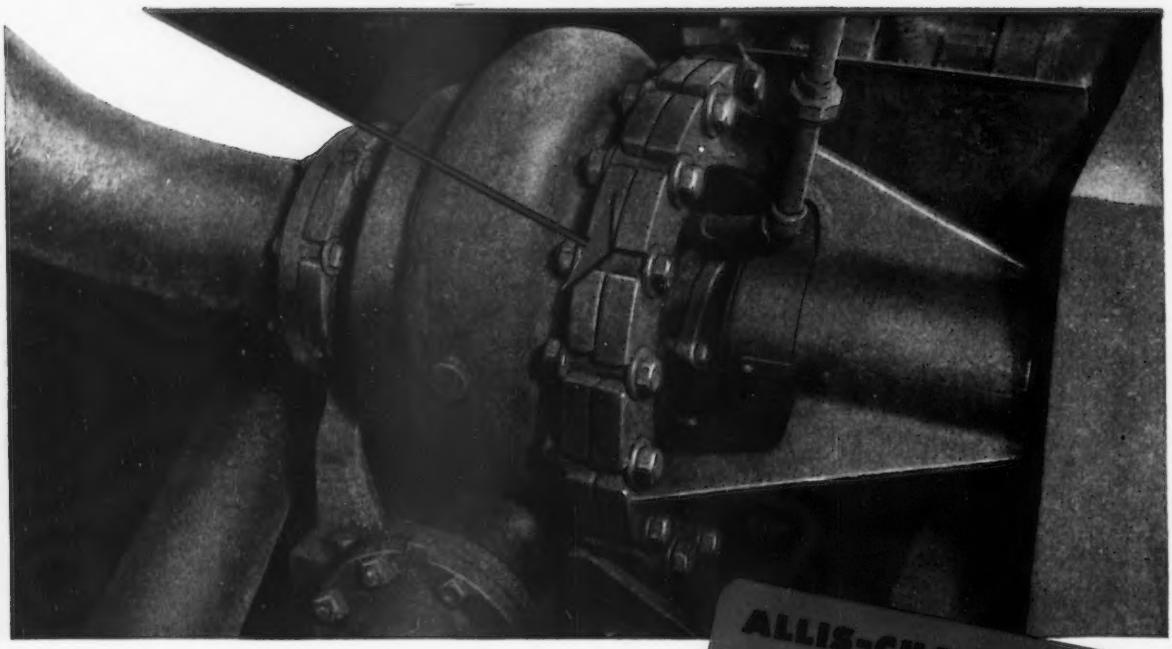
Consult a Joy Engineer

JOY

W&D M 4

WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT

Here's a Pump That Maintenance Men Like



ALLIS-CHALMERS Solids Handling PUMP

- **All maintenance points are easy to reach**
- **Pump can be taken down and returned to service in less than a half hour**
- **Many parts are interchangeable between different pump sizes**

THE Allis-Chalmers solids handling pump is ruggedly built to stand rough solids handling service. And it's easy to work on. Notice how accessible the packing gland is. See how the casing bolts are arranged. Just loosen the nuts a couple of turns and the bolts lift out.

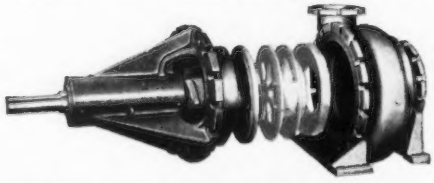
Wearing parts separate into easily handled units. In fact, one man can tear down an Allis-Chalmers solids handling pump, replace a part and have it back in action again *in less than a half hour*. Piping need not be disturbed unless the casing is replaced.

Complete Pumping Unit Furnished . . . Allis-Chalmers can furnish the complete pumping unit — pump, motor, *Texrope* drive and control — assembled and ready to install and run. A *Vari-Pitch* V-belt drive makes it possible to vary head and capacity at the turn of a crank.

Get the Complete Story . . . Every Allis-Chalmers solids handling pump is application engineered by a specialist who knows solids handling equipment problems and how to solve them. Your nearby Allis-Chalmers representative will be glad to give you complete facts and figures on CW pump performance. Or write Allis-Chalmers, Milwaukee 1, Wisconsin and ask for Bulletin 52B6381.

A-4137

NOW . . . even longer wear

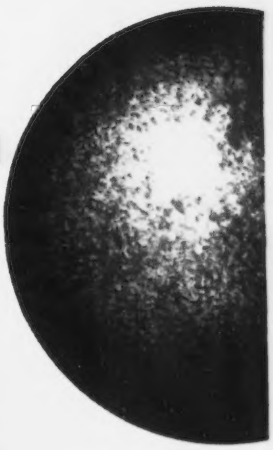


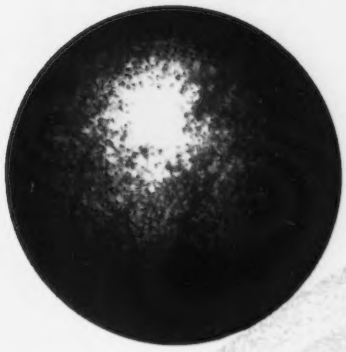
Impeller and suction plate now made of *Ni-Hard* alloy at no extra cost. You get longer wear, lower pumping costs.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

CF&I FORGED STEEL GRINDING BALLS





For greater through-put, even wear and maximum grinding efficiency . . . for high impact and abrasion resistance . . . CF&I Grinding Balls are forged from special analysis steel to strike the balance between toughness and hardness. Strict production control, from ore to the finished product, assures a grinding medium of top performance and uniformity.

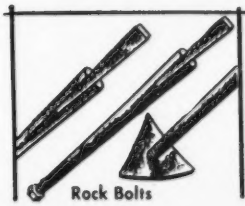
IN THE HEART OF THE WESTERN MINING AREA
PUEBLO ♥ COLO.

THE COLORADO FUEL AND IRON CORPORATION • Denver and New York
PACIFIC COAST DIVISION • Oakland

CF&I
FORGED STEEL GRINDING BALLS
THE COLORADO FUEL AND IRON CORPORATION

1790

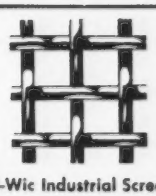
other CF&I products for the mining industry

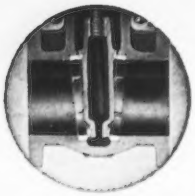

Rock Bolts

Grinding Rods

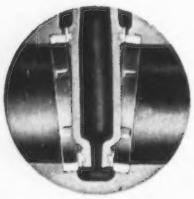
Wickwire Rope

Mine Rails and Accessories


Cal-Wic Industrial Screens

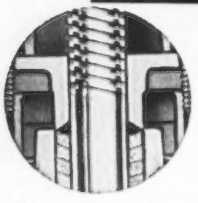


Straight-Flow Port Design reduces fluid turbulence to a practical minimum.



Seat Rings of end-seated type are screwed into the body.

Sure-Grip Malleable Handwheel for non-skid gripping even with heavy gloves.



Brass Liner on Glands assures greater resistance to corrosion and scoring.

WALWORTH

iron body gate valves

with screwed or flanged ends

... 8 Outstanding Features

For complete information on these new Walworth Iron Body Valves, see your local Walworth distributor, or write for bulletin 106.

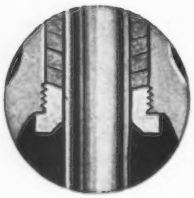
WALWORTH

valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

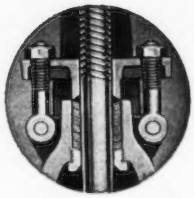
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

T-head Disc-to-Stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.



Bronze Back-Seat Bushings in bonnets of OS&Y valves.

Solid Web Type Disc in OS&Y valves for greater strength and longer service.

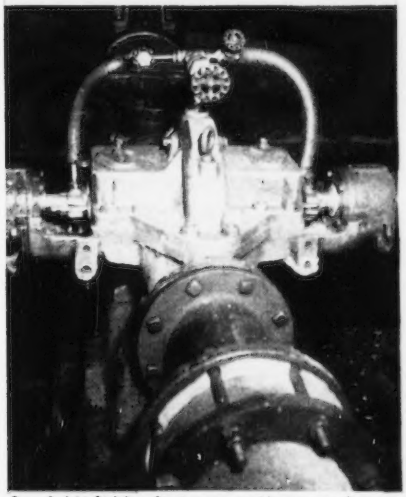


Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

This Stainless Steel clamshell bucket loads moist copper from drying cells into railroad cars for the smelter. It has been in service for six years without need for repair—a constant problem with buckets used previously.

In recovery of "cement copper" at a large copper mine in the Southwest

Stainless Steel's corrosion resistance pays off again



One of eight Stainless Steel pumps used in recovery of copper from waste ore at a mine of a large Southwestern copper producer. The pumps have been in use since 1943 and show no sign of wear.

● To meet the tremendous current demand for copper, producers are turning to their waste ore dumps and making use of the "cement copper" process to recover valuable tonnage. To handle the highly acid materials involved, they've found that nothing can equal Stainless Steel.

One of the larger copper producing companies in the Southwest is using eight Stainless Steel single-stage horizontal high-head pumps to move the copper sulphate solution from the bottom of the dump to reaction cells filled with tin cans.

These pumps have been in service since 1943—handling a thousand gallons of the corrosive liquid per minute. Yet today, after nine years' operation, the mine superintendent points out that they still show no sign of wear. Rubber-lined pumps used previously lasted only a few weeks to a few months.

In loading the moist, almost-pure copper from drying cells to railroad cars for transportation to the smelter, Stainless Steel comes into the picture again. The one-yard clamshell bucket is made entirely of Stainless, and it also shows no sign of wear after six years of service. Buckets previously used required constant repair.

There are many spots in your operation—from mine to smelter—where Stainless Steel's resistance to corrosion, abrasion and severe temperatures can reduce maintenance, eliminate shutdowns and raise overall efficiency. Our engineers will be glad to advise you on grades of U·S·S Stainless Steel that best meet the requirements of the application.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND · COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH · TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

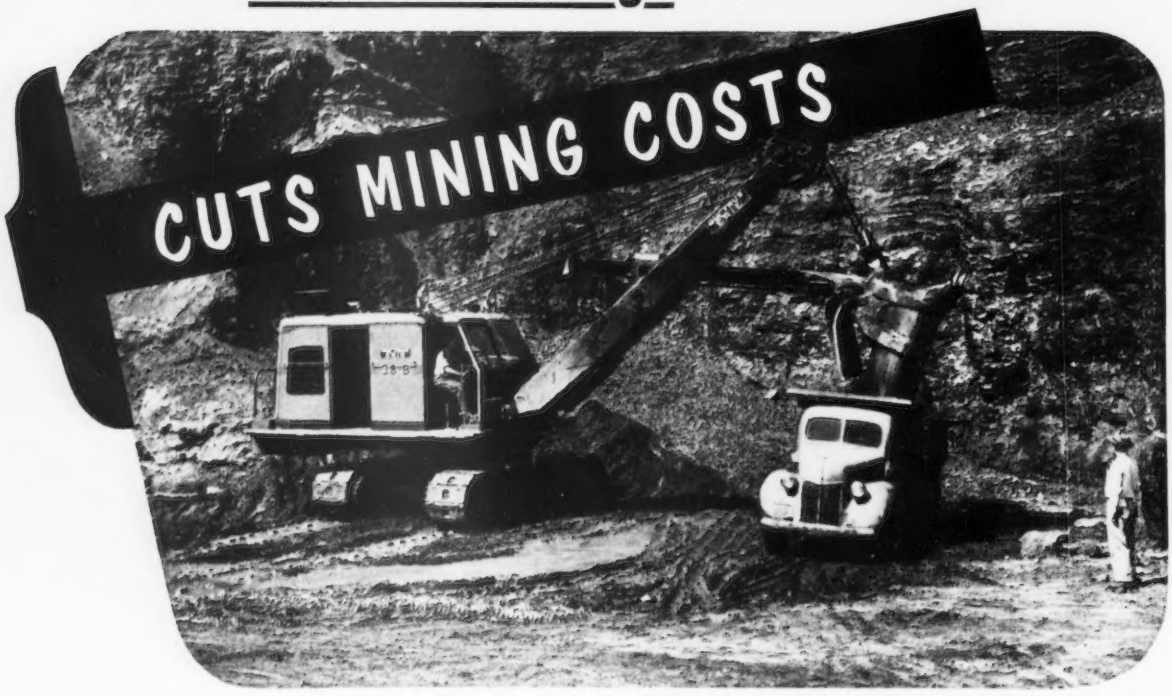
U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

2-959

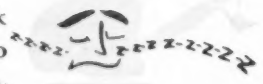
UNITED STATES STEEL

How Individual Design In Excavators



A "line" of excavators **can** be built from a few basic models. Add some counterweight, speed up the engine, boost the dipper size — and one model becomes a larger size. It **can** be done . . . but **you** pay when it is. Here's what usually happens . . .

Some Excavators Will Be "Gold-Brickers" . . .



like this one. It will work fast and easy and no wonder! It's so over-powered it can fill its undersize dipper while loafing. But you are paying for power you can't use, twice over — in both higher initial cost and increased operating cost.

Some Others Are Weaklings

. . . such as this. The oversize dipper puts damaging stress and strain on every part. Every load it lifts speeds it on its way to the unhappy end of a shorter life. You'll be replacing parts often, taking it out of service for maintenance — and wasting production time.

Bucyrus-Erie Offers You Individual Design . . .

each model is built individually from crawler treads to boom point. Every part is properly proportioned and coordinated for maximum efficiency at its rated capacity. No parts are interchangeable with other models. All are matched for top performance.

What Individual Design Means to You . . .

Individual Design means big loads, fast digging cycles, more output every shift . . . ***without*** excessive operating costs. Your Bucyrus-Erie distributor has the complete story. Let him explain further what Individual Design can mean to you specifically on your own mining jobs. 38E53

Bucyrus-Erie excavators are available from 3/8- to 4-cu. yd. gasoline, diesel, and single-motor electric shovels, draglines, cranes, clamshells, dragshovels (no 4-yd. dragshovel).

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

"Plain Primacord will hug the Plastic in a tight double hitch...

"I use Plastic Reinforced Primacord for unusual wet conditions, and in deep holes, or wherever field shots must stand a long time before blasting. It has a tough, plastic cover and will take a lot of punishment. It is not affected by high summer heat or winter cold.

"I use a trunk line of flexible Plain Primacord and make a double half hitch around the Plastic Reinforced branch line at a right angle, like this. The textile covered Plain Primacord grips securely in a tight double loop around the plastic cover without slipping.

"Tight right-angle Primacord connections all along the line go a long way toward giving you a good shot every time."

Ask your explosives supplier or write for further facts to

THE ENSIGN-BICKFORD COMPANY
Simsbury, Connecticut
Also Safety Fuse Since 1836

Here **Plastic Reinforced Primacord** is used for the branch line, and **Plain Primacord** for the trunk line. Note the double half hitch around the plastic cover. It pulls up tight and stays that way.

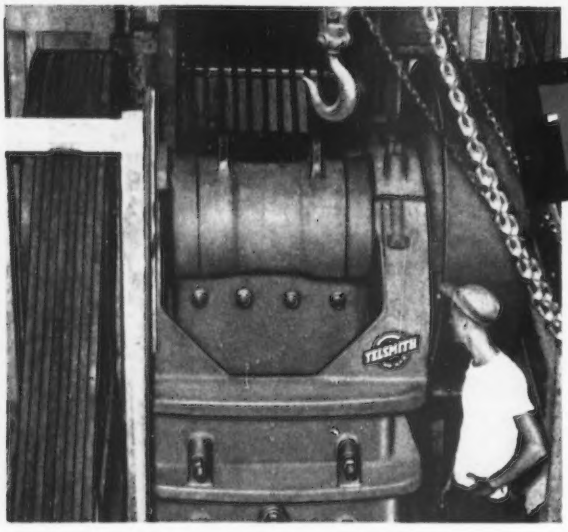
Other brands to serve your needs are: **Reinforced Primacord,** for deep holes and resistance to abrasion; and **Wire Countered Primacord,** for deep, ragged holes.

P-3

Use PRIMACORD

The PROVED and APPROVED DETONATING FUSE

Headframe and concentrator of Bluebell Mine at Riondel, British Columbia



Since placed in operation at the Bluebell Mine in April, 1952, this 25" x 36" Telsmith has crushed about 95,000 tons in less than six months. Telsmith Jaw Crushers are made in 9 sizes: 10" x 16" to 30" x 42"; capacities: 22 to 300 tons per hour.

Send for Bulletin 280.

TELSMITH

Jaw Crusher

in one of Canada's oldest mining operations

Over 100 years ago Indians and trappers got lead for bullets from the ore deposits on the shores of Kootenay Lake, near Trail, British Columbia. And here, today, the new mill of The Consolidated Mining and Smelting Company of Canada Limited, is handling large quantities of lead-zinc-silver ore to produce lead and zinc concentrate. All primary crushing is satisfactorily handled by a Telsmith 25" x 36" Jaw Crusher at the rate of about 100 tons per hour.

Min. 35

SMITH ENGINEERING WORKS, 502 E. CAPITOL DRIVE, MILWAUKEE 12, WISCONSIN

Cable Address: Sengworks, Milwaukee

Samuel Osborn (S. A.) Ltd., Johannesburg, So. Africa • 51 East 42nd St., New York 17, N. Y. • 211 W. Wacker Dr., Chicago 6, Ill.

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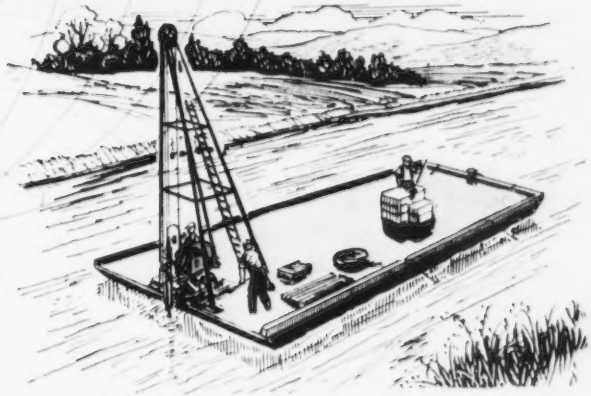
Robert S. Bailey, Los Angeles 17, Calif. • Ontario Eqpt. & Supply Ltd., Toronto, Canada • Gordon Russell, Ltd., Vancouver, B. C.

THE SUN NEVER SETS...

...ON SPRAGUE & HENWOOD'S

CONTRACT Diamond Core Drilling OPERATIONS

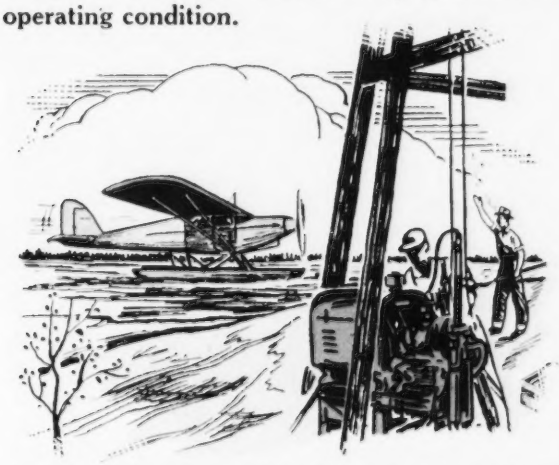
ANY KIND—
ANYWHERE—
ANY TIME—



For more than sixty years Sprague & Henwood, Inc. has been a leader in the field of Contract Diamond Drilling. During this long period our crews have completed thousands of contracts successfully in every corner of the globe—under every conceivable operating condition.

From shallow holes to depths of more than a mile—in regions so remote that men and equipment were delivered by float planes—from barges on lakes and rivers—in mountain terrain so wild that mule-back transportation was required—from the blazing tropics to the sub-zero arctic—our crews have overcome every difficulty and completed their assignments to the customer's satisfaction.

Today, we have a large force of experienced operators and supervisors and an ample supply of modern equipment for every drilling requirement, so that we can undertake almost any job—anywhere—on very short notice.



Besides exploratory drilling for coal and ore, from the surface or underground, our contract service includes blast-hole drilling, directional drilling, foundation test drilling, grout holes and pressure grouting. Estimates, and constructive suggestions whenever possible, submitted promptly on request.

SPRAGUE & HENWOOD, INC.
SCRANTON 2, PA.

Manufacturers, also, of high-speed diamond drilling machines, diamond bits and complete accessory equipment. Write for catalog.

Branch Offices: New York • Philadelphia • Pittsburgh • Grand Junction, Col. • Buchans, Newfoundland

Iron ore..

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Pumping costs can be lowered and production increased with highly efficient Wilfley Sand Pumps. Wilfley Sand Pumps have earned a reputation for making actual dollar savings in operating and maintenance costs. These famous pumps operate continuously, without attention, on 24-hour schedules. Individual engineering on every application. Write, wire for complete details.

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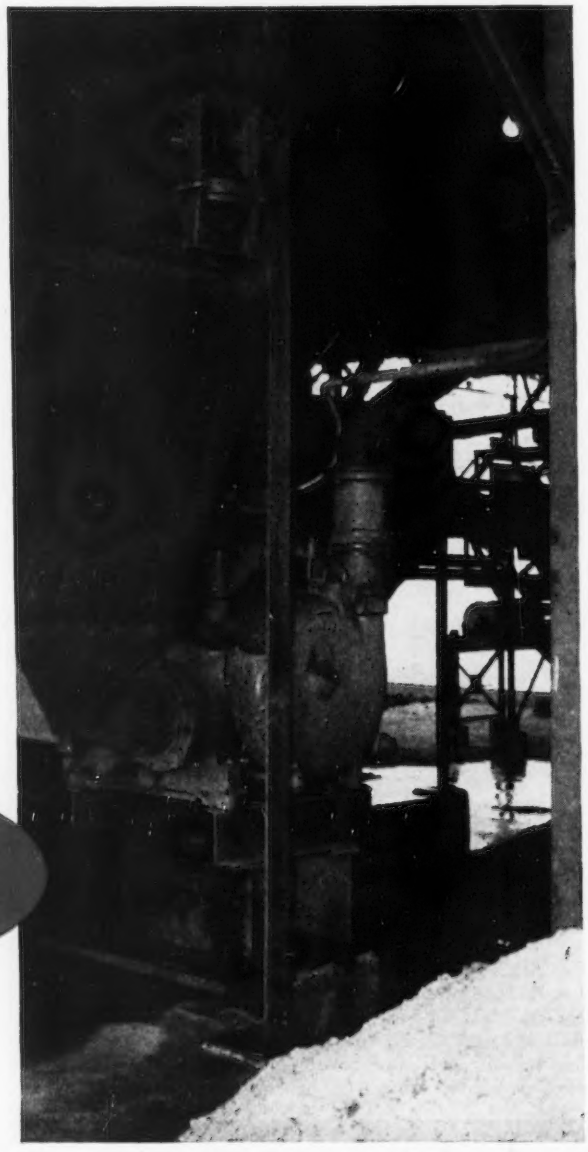
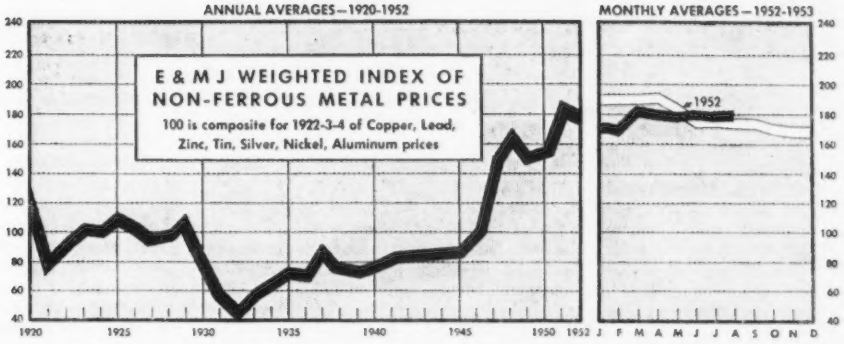


E&MJ OUTLOOK

PRICES



MARKETS

Despite unsettlement in prices in general, including the stock market, the *E&MJ* price index for nonferrous metals inched up in August to 182.70, against 182.20 for July, and 178.70 a year ago. Higher lead and aluminum averages offset lower averages for copper, zinc, and tin.

Tin producers are determined to control production and stabilize prices. This accounts for the price increase from 78¼¢ to 83¢ in August.

Competition from aluminum is one of the big worries of copper and zinc sellers today. Chief threats are die casting, aluminum-clad steel, and electrical conductors.

Smoke hasn't cleared yet from last month's "bombshell" in the zinc market—the dual price system, with some sellers quoting delivered prices for Prime Western, and others quoting East St. Louis. AS&R's return to the East St. Louis basis on Sept. 2 signals a trend.

An important segment of major copper producers discounts the significance of current London Metal Exchange trading in copper. Reasons given include: Lack of trading volume, lack of convertibility of world currencies, and continued government intervention in free copper trading.

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LABOR

The Justice Department is cracking down harder on left-wing influences in labor. Indictments for Taft-Hartley violations are increasing—the most recent being that of Ben Gold of the Fur Workers.

Threats of a national strike in the nonferrous metal industry evaporated by the deadline, Sept. 1. By that time major companies settled for an 8½¢ hourly wage increase.

•

AT HOME

Opinion is virtually unanimous that the steel rate will sag. Indicators are: Cautious buying of manganese and chrome ores, and certain alloying materials; also a wobbly steel scrap market.

Airplane producers report that more than half the nation's output of planes is jet-powered—a boon for high-temperature metal producers.

Cramet Inc. has awarded contracts for construction of a $25-million titanium plant. Capacity is to be 6,000 tons of sponge yearly.

Magnesium as a motor fuel to compete with gasoline is the exciting prediction of Dr. Scharen of Reade Manufacturing Co. He says that one pound of powdered magnesium fuel worth 56¢ will deliver as much power as 10 gal. of gasoline.

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ABROAD

Quebec Metallurgical Industries, with a file full of patents for chemical extraction of metal from ore, has ambitious projects lined up for nickel, cobalt, tungsten, and iron.

MARKETS—Trends and Prices

U. S. Submits Terms to Chile for Purchase of 84,000 Tons of Surplus Copper for Stockpile

THOUGH THE VOLUME of metals moving into consumption continued at near peak levels throughout August, the buying movement moderated. With competition in marketing finished products, including automobiles and housing, increasing, buyers appeared to be more inventory conscious than at any time so far this year. Steel producers were particularly chary in entering into forward commitments, indicating that they not at all certain about their ability to maintain production at current high levels. This was reflected in some unsettlement in manganese and chrome ores.

Public Law 208, which extends the domestic purchase program on tungsten ore, beryllium, mica, chrome, manganese, asbestos, and columbium-tantalum to June 30, 1958, was signed by President Eisenhower on Aug. 12.

Outstanding in developments was the news that Chile has entered into negotiations with the U. S. to dispose of its surplus copper accumulated at prices which consumers refused to pay. It was announced officially that the U. S. Government decided on a set of terms under which it would be willing to meet Chile's request that the U. S. purchase the copper "to relieve a serious financial crisis." Officials disclosed, after a meeting held in Washington on Aug. 26, that 84,000 tons was available under the deal. Copper purchased from Chile would go into the strategic stockpile. Matters discussed in connection with the offer included price, foreign exchange, and a possible loan, according to unofficial reports.

Chile's unrealistic stand on pricing copper in a "buyers" market has resulted in a 30% cut in production of the metal and virtual cessation of all construction programs.

Price Index Steady

Trading in copper on the London Metal Exchange resumed Aug. 5 after a lapse of 14 years. The first session settled with cash at £215 bid, per long ton, and three months at £200 bid. The asking prices at the first session settled at £217½ for cash and £202½ for three months. At the second session prices lost from £4½ to £5 per long ton. The market opened weaker than generally anticipated, but after the excitement died down it soon steadied. European and U.K. consumers, who obviously had gotten themselves into an underbought condition, began looking around for bargain copper and found it was not to be had. This resulted in a general recovery in the price on nearby metal to near the world basis. Cash copper settled in London on August 31 at £228 asked, equivalent to around 28⅝c. per pound.

The *E&MJ* index of nonferrous metal prices, based on monthly averages for August, was remarkably steady, moving up a fraction of a point to 182.70, against 182.20 in July. Copper, zinc and tin averages were slightly lower, compared with the preceding month, but lead and aluminum were higher.

Copper Supply Improving

The supply outlook for copper continues to improve here and abroad. Stocks have increased (see page 106). However, operators who entertained bearish views a month or two ago now admit that two factors have come into the picture to steady the price structure. One was the Chilean situation, which temporarily kept a large block of copper from the open market, and the other was the continued high rate of actual consumption of the metal in the U. S.

During the seven months that ended in July, U. S. fabricators shipped products that contained 848,877 tons of copper. This compares with 770,-152 tons shipped in the Jan.-July period of 1952. Most observers now look for a reduced rate of consumption to take place over the remainder of the year.

Lead Holds Gains

Demand for lead in the domestic market was fairly active throughout August and producers maintained the selling basis at 14¢., N.Y., without difficulty. The fact that the squeeze in prompt metal in London continued for the third consecutive month no doubt was a factor in strengthening prices locally. Prompt lead on the London Metal Exchange sold at a premium of almost £6 per long ton over the three-months' position.

The f.a.s. Gulf market on foreign lead varied between 12¢ and 12½¢ per pound during August.

Dual Pricing in Zinc

It was a case of "no progress" in the matter of settling the pricing problem in Prime Western zinc. Sales were made throughout the month on both the East St. Louis basis and the new delivered basis announced by A.S. & R. Co. in the preceding month. As the month ended, all sellers were meeting competition, and at times this resulted in a little irregularity in the daily *E&MJ* zinc quotation. So far only the consumer has benefited by the move, particularly where freight rates formerly boosted the delivered price on the common grade by more than 80 points over East St. Louis.

The market for zinc was unsettled as the month ended, with so-called outside metal, including some of the 18,-000 tons stored in Commodity Exchange warehouses, pressing on the price structure. Production of slab zinc continues in excess of the needs of consumers.

Tin, after a long slide downward, steadied on prospects of a general meeting of producers and consumers at the government level to regulate production and stabilize prices. It is believed that producers are aiming at

Average Prices for August (E&MJ Quotations)

Copper:	
Electrolytic, domestic, refinery	29.611
Electrolytic, export, refinery	29.254
Lead:	
Common, New York	14.000
Common, St. Louis	13.800
Silver and Sterling Exchange:	
Silver, New York per oz.	85.250
Silver, London, pence per oz.	74.000
Sterling Exchange, "Checks"	281.533
Zinc:	
Prime Western East St. Louis	10.982
Prime Western, delivered (g)	11.252
Tin:	
New York Straits	80.596
New York, 99% min. (e)	79.596
Gold, per oz. U.S. price	$35.000
Quicksilver, per flask	$188.308
Antimony (E&MJ) (d)	37.970
Antimony, bulk, Laredo	34.500
Antimony, in cases, Laredo	35.000
Platinum, refined, per oz.	$92.615
Cadmium (a)	200.000
Cadium (b)	207.500
Cadium (c)	215.000
Aluminum, 99% plus, ingot	21.500
Magnesium, ingot	27.000
Nickel (f)	60.000

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 75 lbs.
(a) Cadmium average based on the producers' quotations.
(b) Cadmium average based on the average of the producers' and platers' quotation.
(c) Cadmium average based on platers' quotation.
(d) Domestic, 5 tons or more but less than carload lot, packed in cases, f.o.b. New York.
(e) Tin content.
(f) F.o.b. Port Colborne, U.S. duty included.
(g) Delivered east of Rockies.

Markets Continued on Page 106

a price of approximately 90¢ a pound.

Quicksilver was unsettled as buying continued at a slow pace and purchases by the U. S. Government appeared to have ended.

The nickel situation has been easing and consumers have asked that the regulations be eased. The authorities in Washington have agreed to review the supply outlook. Defense and Atomic Energy now take about 40% of total supply.

Manganese ore was inactive, with consumers pressing for lower prices. Reduced activity was also noted in chrome ore, with some producing areas reporting easier prices.

"Free" Gold Market

Dollar and gold shortages are forcing various governments to conclude bilateral trade agreements. The turnover in the "free" gold market during August was down about 20%, compared with July. Prices fluctuated within narrow limits. Pick's World Currency Report quotes on "free" gold as follows, per fine oz.:

	COINS		BARS (12.5 kg.)	
	July 31	Aug. 31	July 31	Aug. 31
NEW YORK, transit	.....	.....	$36.50	$36.50
MANILA	$43.50	$43.00	36.25	36.50
HONG KONG	44.50	44.00	38.70	38.50
BOMBAY	49.00	48.00	48.00	47.50
TANGIER	43.75	42.60	36.45	36.50
BEYROUTH	43.50	42.65	36.60	36.60
PARIS	49.75	50.00	36.50	37.60
BUENOS AIRES	44.00	43.00	41.00	39.75

Note: All prices are computed at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

Aug. 1953	Electrolytic Copper (a) Domestic	(b) Export	Straits Tin New York	Lead New York	Lead St. Louis	Zinc Delivered (f)	Zinc East St. Louis
1	No Market	29.475	78.250	14.000	13.800	11.250	10.730
3	29.700	29.350	78.250	14.000	13.800	11.370	11.000
4	29.700	29.550	78.250	14.000	13.800	11.250	11.000
5	29.700	29.550	78.750	14.000	13.800	11.250	10.890
6	29.625	29.225	78.250	14.000	13.800	11.225	10.900
7	29.700	28.950	78.750	14.000	13.800	11.200	11.000
8	No Market	29.450	78.750	14.000	13.800	11.250	11.000
10	29.700	29.875	78.500	14.000	13.800	11.250	11.000
11	29.700	28.850	78.500	14.000	13.800	11.250	11.000
12	29.450	29.150	78.750	14.000	13.800	11.250	11.000
13	29.625	29.150	79.250	14.000	13.800	11.250	11.000
14	29.575	29.100	80.250	14.000	13.800	11.250	11.000
15	No Market	28.950	80.250	14.000	13.800	11.250	11.000
17	29.450	28.675	83.000	14.000	13.800	11.250	11.000
18	29.300	28.825	83.000	14.000	13.800	11.250	11.000
19	29.500	29.200	83.000	14.000	13.800	11.250	11.000
20	29.500	29.250	82.250	14.000	13.800	11.250	11.000
21	29.575	29.275	81.250	14.000	13.800	11.250	11.000
22	No Market	29.275	81.250	14.000	13.800	11.250	11.000
24	29.625	29.325	81.500	14.000	13.800	11.250	11.000
25	29.675	29.650	82.250	14.000	13.800	11.250	11.000
26	29.700	29.525	83.000	14.000	13.800	11.250	11.000
27	29.625	29.400	82.250	14.000	13.800	11.250	11.000
28	29.700	29.150	82.500	14.000	13.800	11.250	11.000
29	No Market	29.150	82.500	14.000	13.800	11.250	11.000
31	29.700	29.275	83.000	14.000	13.800	11.250	11.000
AVERAGES FOR MONTH							
Aug.	29.611	29.254	80.596	14.000	13.800	11.252	10.982
AVERAGES FOR WEEK							
Aug.							
5	29.700	29.375	78.375	14.000	13.800	11.270	10.937
12	29.635	29.250	78.583	14.000	13.800	11.238	10.983
19	29.490	28.983	81.458	14.000	13.800	11.250	11.000
26	29.615	29.383	83.000	14.000	13.800	11.250	11.000
CALENDAR WEEK AVERAGES							
Aug.							
1	29.695	29.346	78.625	14.000	13.800	11.279	10.955
8	29.685	29.346	78.500	14.000	13.800	11.258	10.965
15	29.610	29.179	79.250	14.000	13.800	11.250	11.000
22	29.465	29.083	82.292	14.000	13.800	11.250	11.000
29	29.665	29.367	82.333	14.000	13.800	11.250	11.000

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Aug. 1953	Sterling Exchange "Checks"	Silver (c) New York	Silver (c) London	Gold London	Gold (d) United States
1	(e)	(e)	(e)	(e)	$35.00
3	281.6250	85.250	Holiday	Holiday	35.00
4	281.6250	85.250	74.000d.	248s.	35.00
5	281.6250	85.250	74.000d.	248s.	35.00
6	281.6875	85.250	74.000d.	248s.	35.00
7	281.6875	85.250	74.000d.	248s.	35.00
8	(e)	(e)	(e)	(e)	35.00
10	281.6875	85.250	74.000d.	248s.	35.00
11	281.7500	85.250	74.000d.	248s.	35.00
12	281.6875	85.250	74.000d.	248s.	35.00
13	281.6875	85.250	74.000d.	248s.	35.00
14	281.6250	85.250	74.000d.	248s.	35.00
15	(e)	(e)	(e)	(e)	35.00
17	281.6250	85.250	74.000d.	248s.	35.00
18	281.6250	85.250	74.000d.	248s.	35.00
19	281.6250	85.250	74.000d.	248s.	35.00
20	281.4375	85.250	74.000d.	248s.	35.00
21	281.4375	85.250	74.000d.	248s.	35.00
22	(e)	(e)	(e)	(e)	35.00
24	281.5000	85.250	74.000d.	248s.	35.00
25	281.5000	85.250	74.000d.	248s.	35.00
26	281.3750	85.250	74.000d.	248s.	35.00
27	281.1250	85.250	74.000d.	248s.	35.00
28	281.1250	85.250	74.000d.	248s.	35.00
29	(e)	(e)	(e)	(e)	35.00
31	281.1250	85.250	74.000d.	248s.	35.00
AVERAGES FOR MONTH					
Aug.	281.533	85.250	74.000d.	—	$35.00
AVERAGES FOR WEEK					
Aug.					
5	281.600	85.250	—	—	—
12	281.700	85.250	—	—	—
19	281.638	85.250	—	—	—
26	281.450	85.250	—	—	—

Calendar Week Averages, New York Silver: Aug. 1st, 85.250; 8th, 85.250; 15th, 85.250, 22d, 85.250; 29th, 85.250.

(e) No market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300¢ per pound, the average differential for delivery charges.

(b) Our export quotation for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075¢ for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingotbars; cathodes are sold at a discount of 0.125¢ to 0.15¢ per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered, in the East, Middle West, and West, effective Jan. 1, 1951, commanded a premium of 1.35¢ per pound over the current market for Prime Western; Special High Grade 1.50¢.

(f) Prime Western zinc sold on delivered basis, east of Continental Divide.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points.

(c) The daily New York silver quotation reported by Handy & Harman is for silver contained in ores and other unrefined silver-bearing materials, in cents and fractions of a cent per troy ounce. It is determined by Handy & Harman on the basis of actual sales of bar silver .999 fine in amounts of 50,000 ounces or more for nearby delivery at New York, as reported daily by regular suppliers, and is usually one-quarter-cent below the price paid for such bar silver, this deduction being the allowance to such suppliers for carrying, delivering and marketing. In addition to foreign silver, the quotations also apply to domestic silver if such silver enters into the New York market.

The Treasury's purchase price of newly mined domestic silver is 90.5¢ per troy ounce 1000 fine, effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price. Actual payment by the United States Treasury for gold is at .99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Behind the By-Lines . . .

G. P. Lutjen

Nothing but high grade awe is what we have for Charles Steen. Starting on a shoestring, struggling through disappointment and hardship, he has developed a uranium mine which has already produced over a million dollars worth of ore. The story of his achievement on p. 72 is strictly from Horatio Alger Jr. except that this is non-fiction. Every man who is putting his back, heart and family finances into a hole in the ground, should get a lift out of this story. (The next round may still hit the jackpot.) And for those who have never experienced the adventure of running their own show, "Uranium Jackpot" should provide an insight into the perseverance and courage of the small miner.

Infantry platoon sergeants are almost universally, men of varied talents, but William Wendt is the first one we have come across who has a talent for metallurgy. In the interest of extreme accuracy, we should state that Mr. Wendt is really an ex-platoon sergeant, having served for five years in that capacity during the 1941 war, but the statement on his metallurgy stands. Exhibit A, "Ammonia, Ammonium Carbonate Leaching of Low Grade Oxidized Zinc Ores" appears on pp. 84 to 90.

Following graduation from Oregon State College as mining engineer, after the war, Mr. Wendt went to work for the Mining Experiment Station, Washington State Institute of Technology, as an assayer and chemist. Working on his own time, a rare practice these days, he made some preliminary tests leaching zinc ores with ammonia, ammonium carbonate solutons. Results were so encouraging, the organization set him up as a regular project.

Starting with this issue we are planning to turn over several columns each month to *E&MJ* readers for exercising their God-given right to comment, complain, praise, question, inform or generally beat their chops on any subject pertaining to the mining industry, from the contents of *E&MJ* to the price of Prime Western zinc. For the enlightenment, interest, or consternation of the other 17,999 subscribers all around the world, we are looking forward to having *you* take advantage of this mad gesture. The "Letters to the Editor" department begins on the contents page, in case you are a non-contents-page type reader. Address your comments to Editor, *Engineering and Mining Journal*, 330 W. 42nd St., New York 36, N.Y.

All out for the 440! American Mining Congress meets this month (September 21-24) at Seattle. We have it on good authority that there will be the customary number of top notch technical papers sandwiched in among the customary number of heart-rending orations on the price of gold. What worries us is that we didn't go into training soon enough this year. We are not quite prepared for hauling our pudgy frame up and down stairs, in and out of meeting rooms; for broken field running in smoke-filled corridors; for the over-ripe olives and bibulous bedlam of cocktail parties. However, this apprehension is merely what one Western mining leader referred to as "the qualm before the storm." When the whistle blows, we'll be in there.

At no charge whatsoever, we have some excellent advice for anyone faced with the problem of flying from anywhere in Michigan to Little Rock, Ark.; *don't try it!* Better you should address yourself in a clear legible handwriting, paste a sufficient amount of stamps on your lapel and get mailed. By plane, not only are connections unseemly, but the entire route is beset by diabolical pitfalls. We know. We tried it last month.

On the first leg of the journey, we had an hour's wait at the Tricity airport for a plane to Chicago. During the wait, a couple of our traveling companions, friendly, urbane chaps, conned us into playing the pinball machine. The innocent suggestion that a token wager be placed on our respective skills soon produced a cold sweat as losses mounted steadily, until at take-off time, we were in the red to the tune of close to one dollar.

At the Chicago airport, after noting that the half hour delay between connections had stretched to 2½ hours, it seemed like a good idea to restore our waning vitality with a cold glass of beer. Beer is a substance which is not to be had at the Chicago airport. To get a glass of beer, one has only to go across the highway. This highway, however, is a 6-lane racetrack with autos roaring along at jet speed in at least two directions. There is also strong evidence that Chicago officials have placed a bounty on pedestrians in the area. We waited fully 20 minutes for a reasonably safe opportunity to cross, and we'd be there yet if two helpful young Boy Scouts hadn't come along and made us their good deed for the day. We solved the problem of the return trip by taking a taxi.

The next leg of the journey took us to Memphis via St. Louis and possibly Tacoma. In Memphis we heeded Mother's words about not talking to strangers and settled down to kill the two-hour wait for the Little Rock plane with the two-day old copy of the local newspaper customarily kept in airports for such occasions. It was unfortunate that the only other client in the place at 1:00 a.m. was a huge gentleman, decidedly under the influence of a substantial amount of alcohol. With 42 vacant seats in the room, not counting an upended milk crate, he chose the seat next to ours, the better to deluge us with his opinions, which were both violent and aromatic. He must have been on a monumental bender for he seemed completely unaware that Coolidge was no longer President and we were fortunate to escape to the Little Rock plane as he began voicing suspicions that we had personally had a very unsavory role in the Teapot Dome affair.

The trip to Little Rock was uneventful except that our seat mate, an elderly lady, was busy smuggling two very vicious and unmannerly Chihuahuas into Arkansas. Take it from us, it just isn't worth trying to fly from Michigan to Little Rock.

ENGINEERING AND MINING JOURNAL

SEPTEMBER, 1953

The Bureau and Politics—II

IN DISCUSSING last month the desirability of a non-political approach to the problem of filling the directorship of the U.S. Bureau of Mines, we didn't realize we had touched on only part of the problem.

Later, last month, too late for comment, we learned that a situation had arisen potentially more troublesome than that surrounding the directorship. In brief, the Eisenhower administration had removed the nine top jobs in the USBM from the protection of Civil Service. The assistant directors and the top division chiefs may now be discharged at any time without a bow to the Civil Service regulations.

This was done, we were told, because these men are in policy-making jobs and it is reasonable to suppose that, being holdovers from the long years of Democratic administration, they may very well find themselves in disagreement with the policies of a Republican administration.

If this should prove to be true, the President wants his Cabinet officers to be in a position to discharge such dissenters so that there will be a unified effort behind his administration's programs.

This is what is meant, apparently, by Eisenhower's reference to reorganization of bureaus for efficient operation; and it is said to be going on in all the bureaus in Washington.

It is further stated that there is no present intention to fire anyone in the Bureau, although it may eventually be necessary to "replace" some of the men thus affected in order to get better men in the job. Let's look for a moment at what actually has been done.

It has now become possible to use nine good jobs in the U.S. Bureau of Mines as political plums instead of just one. We do not say the present Administration *intends* to so use them, but we do say they have made it possible for themselves or some future administration to so use them.

Civil Service was set up to prevent the cut-throat operation of the spoils system, by which efficient operation of government was clearly made impossible. It is hard to see how the Department of Interior has aided efficiency in government by reopening the door to the spoils system.

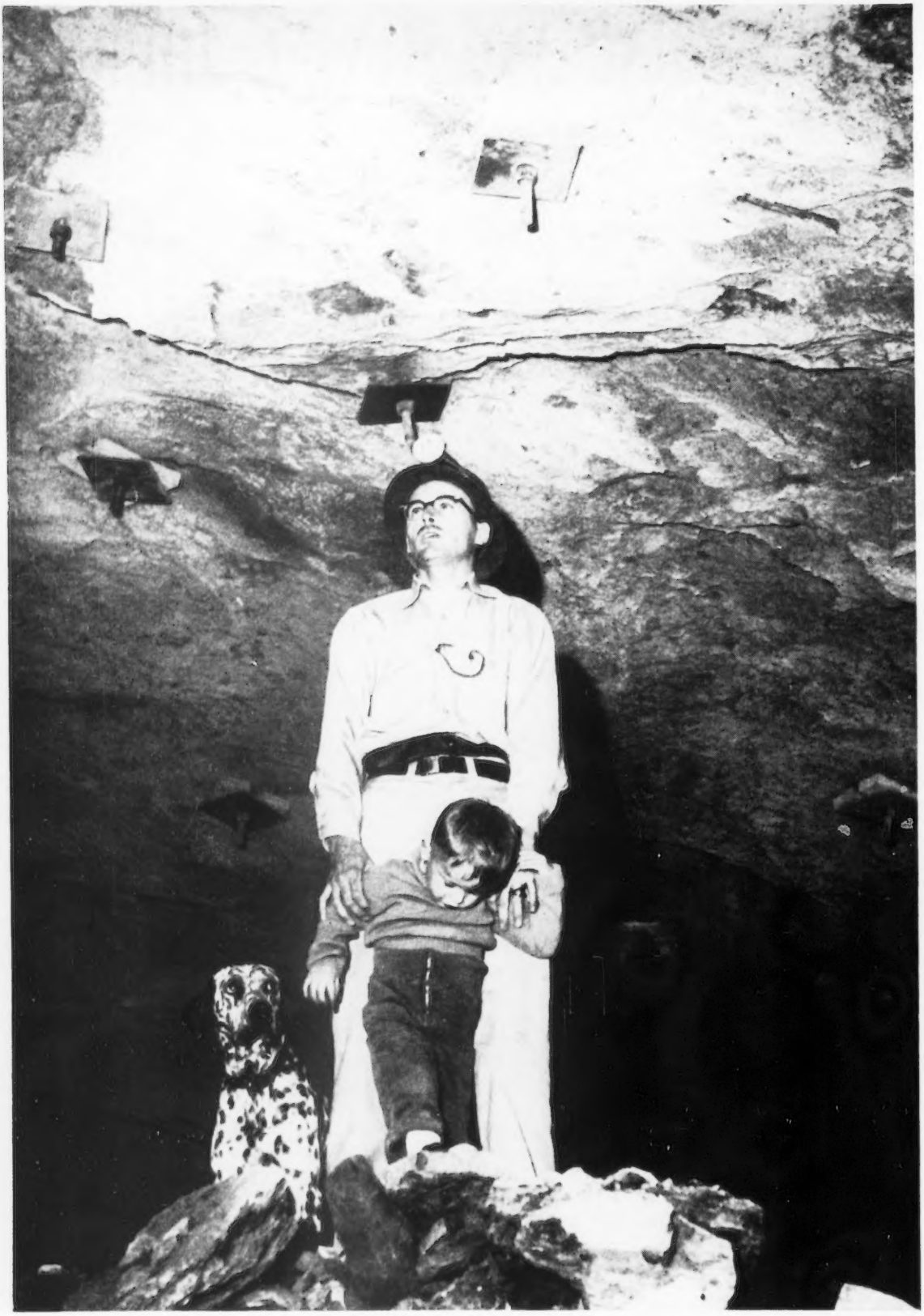
We have repeatedly urged capable mining men to enter government service as a public duty.

How hollow our arguments now sound in the face of this clear evidence that the reward of diligence and faithfulness in government service is to rise eventually to a job from which one can be fired for reasons having nothing whatever to do with one's competence in the job.

This is the real point: Any of us in private industry can be fired for any one of a dozen reasons. We all know what they are. But none of us is likely to be fired from a job we are doing well just because the new boss is a Republican instead of a Democrat.

It can be argued that the Civil Service system protects incompetents. Perhaps it does to some extent, but there are ways, even under Civil Service, by which incompetent men can be shunted out of or away from top jobs. It seems vastly preferable to use those ways, even if it takes longer, than to cripple the whole system by thus proving that only on mediocrity and lack of ambition can one found a successful career in government.

Perhaps the Administration has some justification for this move that is not apparent to us. If so, we invite a spokesman to discuss it in these columns. Meanwhile, we cannot but feel that a mistake has been made, a grave mistake, that the Administration will one day have good cause to regret.



ON TOP OF THE HEAP, among independent uranium producers, Charles Steen and his son look over the mine that in less than a year has produced over a million dollars in primary uranium ore. Note modern roof bolting.

Uranium Jackpot

This is the story of how Charles Steen's determination and good luck built a shoestring prospect into a million-dollar uranium producer

BURT MEYERS (Text)
ROBERT GRANT (Photographs)
Grand Junction, Colo.

"IT'S AMAZING what you can do with a dollar and four claim stakes —if you put the stakes in the right places," says Charles Steen of Moab, Utah.

This 33-year-old Texan is the man who discovered what is now officially rated as one of the largest uranium producers in the United States. It's so large, in fact, that a top Atomic Energy Commission official recently said he is "getting less inclined to talk about it."

Less than a year ago, Charles Steen had nothing but a single-drill hole to support his claim of having found a million-dollar mine. The core from that drill hole revealed uranium ranging up to 5% but skeptics pointed out that a single core couldn't mean much. Today, Steen doesn't have to ship any more ore to justify his declaration that he had a "million-dollar mine." His shipments passed that mark early in August, and the known extent of the deposit is increasing steadily.

According to Sheldon P. Wimpfen, manager of the Grand Junction operations office of the raw materials division, Atomic Energy Commission, Steen's property threatens to become a large enough percentage of domestic production to overshadow the output of most other mines.

A man with faith in himself and the courage to act on that faith, Steen says prospecting is the only thing he really likes to do. And for four years Steen prospected for uranium in the face of obstacles which would have sent most men scurrying back to desks and steady salaries.

During those years, he says, his ability as a geologist was criticized on every side. After he made his big strike in July, 1952, he was accused of being a crackpot, a promoter, or worse. Disbelief met his every assertion of having found "the big one."

While he prospected, his wife and four young sons "lived like sharecroppers" in one-room shacks, without enough clothing to keep warm, and with meals more notable for their irregularity than for their nourishment. At one time, his youngest son, Mark, then 2½ months old, lived on tea and sugar for several days. "I was too broke to buy milk, and my credit wasn't any good," Steen says.

Steen is a 1943 graduate of Texas Western College at El Paso. He worked his way through college as a part-time employee of Chicago Bridge & Iron Co., and became acquainted then with Dan O'Laurie and W. T. Hudson, the two men who were later to provide his financial backing. After graduation, Steen went to work as a jungle geologist for a major oil company in Peru for several years.

When he returned to this country, he continued to work for the oil company until he was fired for insubordination: "The best thing," he says, "that ever happened to me."

Without a job, and unable to get another one as a geologist, Steen was free to go prospecting. But he didn't have the money to wildcat for oil, so he cast about for some mineral that was in demand and that a man with a shoestring, "a mighty slim shoestring," might prospect for with a hope of big returns.

He settled on uranium, he says, after reading an article in *Engineering & Mining Journal* about the still-young industry, which was just beginning to assume its present importance as a domestic mining field.

Steen moved his family from Texas to Cisco, Utah, and bought a red jeep. Then he started his stubborn efforts to win a fortune in the rugged canyons and deserts of Utah.

One of the men who knew him then told this anecdote recently to illustrate Steen's poverty. "A bunch of us caught some catfish in the river there in the Yellow Cat district one time. We were heading back up to camp when we saw Steen's boys standing beside the trail. They had their eyes on those catfish, and they looked so hungry we gave them the string of cats. They ran off with the fish like they'd been shot from a gun. Later we found out there wasn't another thing to eat in their shack except some cornmeal."

Steen's mother, Mrs. Rosalie Shumaker, sold her home and other property in Houston, Texas, to help finance his prospecting, and Steen borrowed to the limit wherever he could. But the money faded away. He found ore here and there and staked some claims, but nothing turned up that he could develop. By the time he made his big strike, he owed a grocery bill at one store of $300, and he was moved to declare: "It's easier to find ore than it is a grubstake."

Then Steen flew over the Big Indian Wash area southeast of Moab in a borrowed plane. He liked the looks of the country and staked some claims.

Unable to raise more capital, Steen moved to Tucson, Ariz., where he did some contract prospecting and worked for a while as a carpenter. Then he was offered a job in New York City, but he decided to "try once more."

He returned to Utah, got hold of a drill rig, and put down a test hole on his Big Indian claims. The core he recovered assayed from 0.34 to 5% U_3O_8 in a belt 72 ft. below the surface, a much shallower horizon than the one in which uranium had been expected. It was a heavy black ore, believed

MODERN EQUIPMENT, like this air-leg drill, has been put to work in Steen's mine. Ore averages about 0.5% U_3O_8.

HIGH GRADE ORE is readied for blasting by Gilman Ritter, powder man. This face averaged about 21% U_3O_8.

to be primary and to be made up of minerals resembling uraninite or pitchblende. The ore does not contain carnotite.

He announced that he'd found a million-dollar mine. And it was then, penniless, ragged, near desperation, that Steen encountered the derision and disbelief that was summed up in charges that he'd salted the drill hole. Steen says now:

"Nobody would believe I really had something. They accused me of salting the hole with pitchblende so I could sell stock.

"But it seemed to me the point was, if I salted it, where did I get the pitchblende to salt it with. Canada?"

Steen turned to the men who'd helped him through college, Dan O'Laurie and W. T. Hudson, both now executives of Graver Tank & Construction Co., Casper, Wyo. They formed Utex Exploration Co., with Steen and his mother holding 51% of the stock. Other shares, and some of the claims he had staked, were distributed among his creditors and the people who'd stuck by him during his years of prospecting.

Utex had enough capital to do more drilling on the claims Steen had staked to determine exactly what was there. But Steen had gambled a long time and he was ready for one more gamble. He used the money to sink a shaft to the orebody indicated by the single drill hole.

"It was bad mining, but good economics," Steen says. He explains that if he had drilled, he would have been out of money with which to mine. He sunk the shaft in the hope of finding enough ore immediately to meet his mining costs. The gamble paid off.

After it was all over, Steen denied that his discovery of uranium far back from any rim outcroppings in an area regarded as barren by other geologists was luck alone.

"It was a calculated risk," Steen says. "I sweated that hole out all the way down, though. Believing it's there and knowing it's there are two different things."

The shaft reached the orebody early last December and Steen made his first shipment of ore to the U. S. Vanadium Company's buying station at Thompson, Utah. Since then, ore shipments have been increasing steadily. By mid-May, $300,000 worth of ore had been shipped. The total reached $1,000,000 in August.

Ore Is Worth Millions

Additional drilling indicates a deposit of many millions of dollars worth of uranium in the Mi Vida (his original mine) alone. Drilling on other claims has turned up commercial grades of ore all around the Mi Vida. The entire area is now staked and is the scene of one of the most intensive exploration efforts in the booming Colorado Plateau. Unofficial reports are that other deposits potentially as important as the Mi Vida already have been turned up. The Little Beaver Co., headed by W. T. Hudson, one of Steen's original backers, has turned up commercial ore 2,900 ft. south of the Mi Vida; 650 ft. away the deposit is 25 ft. thick.

Until recently, at least, the Mi Vida mine has been only in the development stage. Utex leased out 200 ft. of its claim to the G&G Mining Co. of Cortez, Utah, which drove an incline to connect with the original shaft. No waste rock was encountered in driving the shaft.

Using a diesel loader for mucking and cat-drawn trailers for mine cars, G&G moved 4,000 tons of ore in the first four months of its lease. The ore averaged better than 0.50% U_3O_8. In places the company has found ore that is as rich as 21% and hand-picked samples range up to 88%. At 21%, the ore is worth roughly $1 a pound.

Steen is stockpiling all ore averaging above 20% in hopes of being the first man to collect the AEC's $10,000 bonus for the first 20 tons of non-carnotite, non-roscoelite ore assaying at least 20% to be discovered in the U. S. He'll have a race for this bonus, however, as Vance Thornburg, owner of the Seven-Mile mine north of Moab, also is seeking it.

Archie Garwood and Clare Gerlach, partners in G&G Mining Co., say they "ship everything we take out. It's all ore." No waste dump is needed at the Mi Vida.

A diesel truck equipped with exhaust scrubber is now being used in the mine, to speed its operations. When the mine is fully developed, Steen hopes to have another incline driven so a truck may go in at one end, be loaded, and drive out the other incline with a full load for transfer to a hauling truck.

General manager of the mine is

FAST LOADING is purpose of tractor-mounted shovels, diesel-powered haulage. Mine is mechanized to the hilt.

MORE ORE is being sought, and found. This rig is run by Little Beaver Co., directed by Steen's associates.

Bob Barrett, Oren Moore is foreman. Moore had the contract for sinking Steens original shaft.

The mine is fully mechanized, with power and lights from electricity generated at the mine. A dragline is used for mucking. Roof bolts instead of timbering are used. This is one of the first uranium mines in the Colorado Plateau to use roof bolts.

From the standpoint of uranium recovery, Steen's property has one disadvantage. It has a high lime content and can't be handled in its present quantities by existing mill facilities. He can sell it only to the AEC-owned mill at Monticello, Utah, operated on contract by Galligher Co. of Salt Lake City.*

It's being stored there, and Wimpfen, AEC Grand Junction manager, says it's "overtaxing our stockpile area."

The ore is not amenable to the present flow sheet of the Monticello mill, but "We are purchasing the ore to provide a market. We can't let it sit idle when it has that much uranium in it," Wimpfen says.

"As we watch the very important developments of Utex Exploration on the Mi Vida and other claims, the growing indication is that additional milling capacity is needed."

Wimpfen says the AEC has not attempted to set a dollar value on the deposit. "If we evaluated it, it would be in terms of ore reserves, not in dollars," he says. And indications are that the importance of the discovery, in terms of percentage of total ore reserves, is too great to permit release of official estimates. The deposit ranges up to a thickness of 40 ft. for at least 600 ft. from the original shaft.

Steen actually takes little part in Utex's mining operation. He has formed two other companies, Moab Drilling and Big Indian Mines, and is busy prospecting for more ore. He's poured most of the wealth from the Mi Vida into his expanding activities, and the money has made little change in him. True, he drives a big car now, he has new clothes, a Dalmatian dog, and an airplane that he didn't have before. His family lives in a larger apartment in Moab, eats regularly, and is well-clothed. He and his wife have made several trips together, including one to Mexico. But most of the money has gone back into the ground.

"Moves at High Speed"

Steen is a thin, intense man who moves at high speed in everything he does. He's naturally proud of what he's accomplished in opening up an entirely new area for uranium production, and he's proud that he's been able to keep control of the Mi Vida and other claims.

"Believe it or not, we've gone at this conservatively. We haven't bought a thing for Utex that we couldn't pay for. I don't mean to have my kids ever miss another meal."

Steen likes to recall the days when he was broke and hungry, and to keep himself reminded of those difficulties, he's had his battered old prospecting boots preserved in bronze.

The Big Indian Wash discovery has intensified the uranium boom in southeastern Utah. Hundreds of claims—many of them promising ones—have been staked since Steen's discovery proved out.

Among the many individuals and companies operating there now are the Little Beaver Co., headed by Hudson, which is developing claims leased from Bob Barrett; Wilford Brunke, leasing from Dan Hayes; Jack Jones and associates; G. E. Nielson and J. O. Larson; and Great Western Uranium Co.

Hayes, incidentally, has claims staked along the rim of the Big Indian Wash, where some outcroppings occur. Steen did his drilling and staked his claims far back from the rim, where there had been no previous indications of ore. Hayes once owned the Happy Jack mine, a rich producer in central Utah, before its value was known, and also found ore in the Lukachukai Mountains on the Navajo Reservation in Arizona. He sold out his interest in both of those discoveries, but has held on to his Big Buck group.

Uranium Mining Can Pay

Thus Steen, guided by that *Engineering & Mining Journal* article has proved that the small operator can make uranium mining pay with small capital, hard work, and luck. Since there are fewer than a half-dozen mines on the Colorado Plateau that approach the Mi-Vida in output, the small mine operator will still be the mainstay of production.

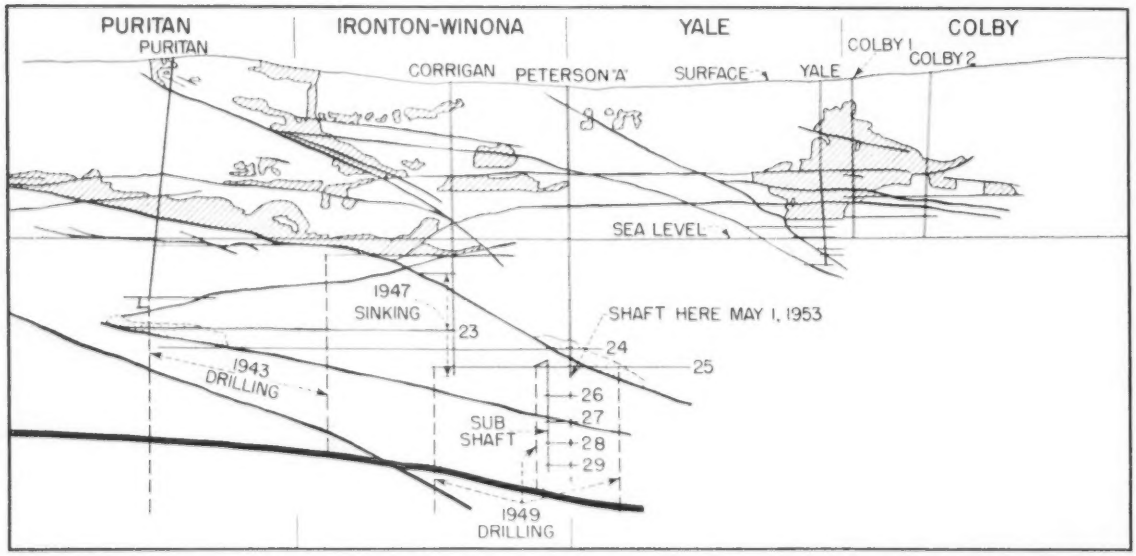
* See "Utah's New Uranium Mill," J. A. Butler, *Engineering and Mining Journal*, March, 1951, p. 56.

PETERSON MINE'S "A" shaft, at left, had reached 25th level, 2,700 ft. below surface on March 27, with 900 ft. more to go to reach 29th level at 3,600 ft., initial objective. Sinking in ledge, 80 ft. below collar, started Sept. 17, 1951.

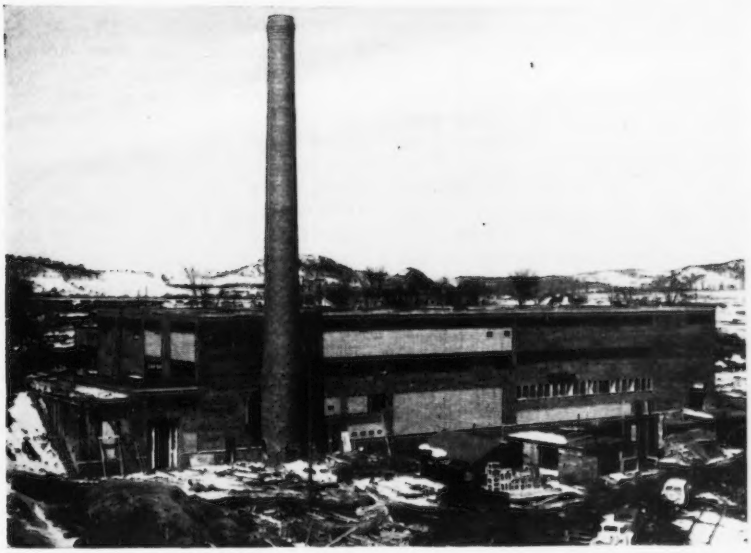
A New Mine for Michigan's Gogebic Range

Result of the redevelopment of four old mines following exploration by drilling at lower horizons, this mine will be in full production by the end of 1955, thanks to the courage of those willing to make the needed investment in face of the considerable risk involved. Favorable tax treatment helped.

IN THE JULY, 1949 issue of *Engineering and Mining Journal*, devoted to the future of mining, the question was raised about the nation's future sources of iron ore required by the continually expanding blast-furnace capacity of the steel industry. The redevelopment of old mines was offered as one of the potential methods of increasing the reserves of the vari-



PETERSON MINE WORKINGS are shown in longitudinal projection, including advance of "A" shaft on May 1 last. Present objective of shaft is 29th level. Diamond-drilling done below old workings in 1943 and 1949 is indicated.



SHOP, DRY, WAREHOUSE AND OFFICE will be housed in this building. Construction is similar to that of engine house opposite.

—The Peterson

ous metals. The current development of the Peterson mine at Bessemer, Michigan, in the center of the Gogebic iron range in the Upper Peninsula, is an example of the considerable field of opportunity in that direction.

The economic core of the Gogebic Range is a ribbon of iron formation, from 500 to 700 ft. thick, that was deposited during Middle Huronian time. It dips downward indefinitely to the north at a steep angle and extends generally east to west for some 65 miles. Lying over the formation are the later Upper Huronian slates and beneath it are 500 ft. of quartzite and quartz slates, which were deposited on the Laurentian granite or basement rock of the district. The whole series is cut by diorite dikes, varying in thickness from inches to tens of feet, that stand approximately at right angles to the bedding and generally pitch down to the east at moderate angles.

At localities favored by faulting within the central 20 miles of the district, bodies of high-grade, direct-shipping hematite were formed within the more permeable cherty horizons of the formation. Groundwater channels developed in the faulted zones and the circulation of oxygen-bearing waters oxidized the primary iron carbonate and dissolved the accompanying silica. Almost invariably, the orebodies lie along the upper surfaces of the dikes, where they sometimes have considerable width and may extend along the dike-troughs for thousands of feet. As the presence of ore on a dike at a shallow depth is not a barrier to the existence of other orebodies on lower dikes, the dikes are important controls for the localization of ore and constitute primary exploration guides.

Four Old Mines

Within a two-mile length of the range in the vicinity of Bessemer, four old mines operating on orebodies lying in the troughs of shallow dikes had followed these down to a maximum depth, in one case to a depth of 1,800 ft. These operations were initiated around 1885 and by 1925, two of them—the Colby and the Yale—had exhausted their known reserves and were closed down. The others—the Ironton and the Puritan—did not reach exhaustion until 1941. During a total operating span of over half a century, these four mines produced a total of 22,906,000 tons of high-grade hematite.

Before the final shutdown in each case, the management explored below their operating levels by drilling or sinking to find new ore on lower dikes, but in no case was the work carried deep enough to find important orebodies. At the Puritan, sinking to a depth of 2,400 ft. failed to reach any important dike, but several small ore pockets were disclosed which, at that elevation, lacked sufficient length and width to justify an operation. At the Ironton, drilling to a depth of 3,150 ft. showed what appeared to be a narrow seam of painty ore in faulted ground, which, due to the adverse depth and difficult ground, did not justify further exploration.

Puritan Company Organized

Other than these meager showings, there was no positive information indicating ore at depth. Coming down from the west, however, are a group of ore-carrying dikes that had yielded over 100-million tons from the mines through which they passed. It was known from experience on the range that these principal dikes have a tendency to continue to carry ore even though cross-features sometimes cause local barren areas. Also, ore was actually known to exist on one of these dikes only a half mile west of the Puritan shaft section. Having these facts in mind, the fee owner of the Puritan and Ironton properties continued to keep those mines dewatered after the former operators had relinquished their leases.

In 1941, the properties were offered to Pickands Mather & Co. as deep exploration possibilities. Backed by a thorough geological study of the area, Pickands Mather thought that the chances of finding ore were good enough to recommend risking a sizeable exploration expenditure to Bethlehem Steel Corporation and Youngstown Sheet & Tube Co. These companies jointly organized and financed the Puritan Mining Co. to assemble all four of the old properties, plus other lands, into a single group under one control and to locate and explore the deeper dikes.

The principal factors governing this decision were the rapidly diminishing reserves of high-grade hematite in the Lake Superior region and the fact that exploration was failing to find new orebodies as rapidly as mining under wartime pressure was depleting old ones. The foreseeable development of extensive deposits in Labrador and Venezuela, while reassuring for the future, did not guarantee an adequate supply

during war and would necessitate heavy investment in plant and transportation facilities. On the other hand, those facilities already existed to serve the Lake Superior area, which is also a comparatively safer location in case of enemy action.

A Long Chance

The exploration below the old mines at Bessemer represented a long chance; however, the participating companies, under the leadership of E. G. Grace and A. B. Homer, chairman and president respectively of Bethlehem Steel Corporation, and the late Frank Purnell and J. L. Mauthe, chairman and president of Youngstown Sheet & Tube Co., could foresee the advantages accruing to both the ore and steel industries, as well as to the communities in the area, from a successful outcome of the project. Their vision in planning the rapid growth of the two companies through the greatest expansion in steel-making facilities in history was also directed toward the necessity of finding and developing a matching supply of raw materials.

After a lengthy and somewhat difficult period of rehabilitation, the lower levels of the Puritan and Ironton mines were re-entered and sites cut for drilling deep diamond-drill holes on one cross-section in each property. At the Puritan, the initial hole was drilled dipping parallel to the formation, but back in the footwall where drilling is the easiest. Its purpose was to determine the elevations at which the deeper dikes lay at the most westerly point in the group of properties. This hole was 2,640 ft. deep or about 4,600 ft. below surface. When the significant dikes were located and identified, their troughs were tested systematically by cross-sectioning holes drilled from sites far out in the hanging-wall slates. A similar cross-section was drilled 1,800 ft. to the east near the west boundary of the Ironton property, except that the dikes were located satisfactorily by projection from the Puritan cross-section and it was not necessary to drill a "dike-finding" hole. Wedging of holes was used.

In the Puritan section, no ore was found in either of the two deep troughs tested. At Ironton, however, two runs of high-grade "soft" hematite were obtained, of 90 ft. and 58 ft. respectively, lying on the quartzite footwall above and between two heavy dikes which chanced to intersect near this point. These showings suggested that a major orebody might exist on the dikes, but they were about 1,700 ft. below the level from which the holes were drilled. Due to the extreme difficulty encountered in getting drill holes down to that depth on controlled courses in this formation, it was felt that no further drilling of the showings from existing levels could be justified, especially in view of the heavy overhead expense involved in keeping the mines open and dewatered.

While the deep drilling was under way, however, a half-dozen short holes were drilled in the Puritan to test the continuity of the several scattered pockets of ore developed by the former operators on the bottom level. These holes showed a dike crossing the property some 400 ft. below the bottom level and indicated that the separate pockets of ore ran together above this dike to form a moderate-sized orebody with a minimum length of 1,000 ft. Circumstances indicated a possible extension eastward and it was thought that ore in mineable width might exist over a sufficient length of this dike to support an economic small-scale mining operation. If so, such an operation might possibly repay or largely defray the cost of sinking to an intermediate level and carry the mine overhead expense while the deeper dikes were being explored by drilling at closer range. Drilling to check the existence of the possible ore extension was not feasible, however, so the decision to risk the further heavy expenditure involved, most of which would be lost with negative results, had to be based on the geological probabilities.

Search Continued Shaft Deepened

Accordingly, it was decided to deepen the vertical Corrigan shaft on the Ironton property 975 ft., or about halfway to the suggested deep orebody, but deep enough to permit recovery of all the ore on the intermediate dike. In 1944, work preliminary to shaft sinking was started, involving the building of a temporary engine house and change house, equipping of a shop, installation of a compressor and two hoists capable of reaching the planned depth, as well as the construction of such auxiliary equipment as needed.

Due to wartime scarcities of materials and manpower, actual sinking did not begin until late in 1946. By the end of 1948, the sinking had been completed, with three levels, called the 23d, 24th, and 25th, established at depths of 2,300, 2,500 and 2,700 ft. respectively. Pumps had been set, crosscuts had been driven out to the iron formation and drifting had been done for considerable distances along the footwall of the formation. It soon became apparent that the ore on the intermediate dike over much of the hoped-for eastward extension from the previously drilled orebody in the Puritan was too narrow to support an economic mining operation. It was, therefore, decided to concentrate all efforts on the deep drilling program and determine the worth of the lower ore showings as speedily as possible.

Ore Found Justifies Plant Construction

The 25th level was then driven eastward about a half-mile with crosscuts to provide drill sites for three cross-sections 1,000 ft. apart, the first being 1,000 ft. east of the original Ironton section drilled in 1943. Diamond-drill holes were put down on each section to the lower dike carrying the 1943 ore showings, starting with a "dike-finding" hole drilled within the footwall slates and parallel to the formation in each case. Cross-sectioning holes drilled from hanging-wall positions then tested the troughs of the dikes so located. Ore was found on each section just above the dike in several horizons of the iron formation. Many of the showings were meager but there were enough runs with fairly substantial footages of ore to indicate the possible presence of an orebody of dimensions which would justify the tremendous cost of providing the entirely new plant required to mine it.

Incidental to the development of the 25th level for drill sites was the discovery of a small orebody lying on one of the upper dikes coming down out of the old Ironton workings. A sudden flow of ponded water amounting to 1,300 gpm was experienced when the porous ore was penetrated. Idle pumping capacity installed against just such a contingency was able to handle the flow. During the deep-drilling period, this orebody was developed above the level by openings and

followed down the trough by several shallow drill holes.

The deep drilling showed that some ore existed to a depth of 1,300 ft. below the 25th level or 4,000 ft. below surface, with no apparent structural reason why the orebody should not extend deeper in its eastward-pitching course down the dike-trough. From a study of the drilling results, it was concluded that the main deep orebody, plus the shallower auxiliary orebodies, could be of sufficient size and distribution to support an operation yielding an annual tonnage at least equal to and perhaps eventually larger than the current output of the major producing mines on the range. Accordingly, a plant was designed involving a completely new shaft with general surface facilities adequate to serve a large-scale operation but which could be readily enlarged whenever underground development should indicate an increased productive capacity. The shaft and hoisting plant, however, being features less readily susceptible to possible later enlargement, were designed to have an ultimate capacity approximately double that of the other initial surface facilities.

Named Peterson

Plans were far enough along by mid-1950 to permit the start of actual construction. The property was named the Peterson mine, in honor of A. F. Peterson, vice president, Mining Division, of Bethlehem Steel Corp. A native of nearby Ironwood, Mr. Peterson's sound judgment on mining matters and his faith in the productive possibilities of the Gogebic Range have been important contributions to the progress of the entire project.

As the actual tonnage of deep ore, which is vital to the economic success of the mine, is not known, the capital expenditure of many millions of dollars required to provide the annual productive capacity planned is indication of the courage of the industrial leaders involved and their faith in the Gogebic Range. There is another very important aspect to the development program. If the expected tonnage materializes, the Peterson should be a long-lived property and the payroll of several hundred men when the mine is in full production, will be an important source of employment to the community of Bessemer and the surrounding area.

Favorable Tax Treatment Encouraged Start

An important consideration affecting the decision to start development was the favorable Michigan property tax treatment on newly discovered ore. This was followed in 1951 by formal legislation, the so-called Lindquist Law, enacted to encourage the exploration and development of the State's mineral resources. In effect, it provides a tax moratorium exempting ore in the geological possibility category, such as the deep ore in this instance, from assessment for a maximum of ten years. If that ore is brought into production during the period, the assessment is then based on five times the average annual tonnage, including the previously proven reserves. It is obvious that this kind of encouragement from the taxing authorities was one of the deciding factors justifying the considerable risk in the heavy investment which may give this area an otherwise unavailable income.

For the initial sinking, it was decided to go four levels or 900 ft. below the 25th to the 29th level, which will be 3,600 ft. below surface with the skip-pit an additional 150 ft. deeper. A site for a new 14 x 23-ft., 6-compartment vertical shaft, called the "A" shaft, was chosen well back in the footwall granite opposite the center of mass of the indicated ore. Test drilling showed 75 ft. of overburden containing some fine sand, necessitating a drop shaft to ledge.

While the drop shaft was being put down to ledge, followed by construction of the headframe and installation of sinking facilities, an extensive pre-development program was initiated underground through the existing Corrigan shaft. The bottom or 25th level was extended over to the proposed position of the new "A" shaft. A hoist room and loading pocket were cut about 1,000 ft. from the "A" shaft position and a vertical, three-compartment, 7 x 17½-ft. sub-shaft was sunk 900 ft. to the 29th level with station cutouts at the 26th, 27th, 28th and 29th levels. Crosscuts were driven over to the "A" shaft position on all of these levels, and stations, pumprooms and sumps were cut so that they will be ready when the shaft reaches each elevation. The subshaft and Corrigan shaft together will eventually serve as an airway and escape outlet, but the immediate function of the sub-shaft has been to hasten development of the lower level.

In addition to the shaft work, rock development has progressed on the 23rd and 24th levels, which are connected to the Corrigan shaft only, so that mining on a limited scale of the ore on the intermediate dikes can be started after a ventilation circuit has been established with the "A" shaft holed through to the 25th level.

After concreting at "A" shaft collar had been completed, a 150-ft. permanent steel headframe was erected. Two temporary electric hoists were installed, a single-drum unit to serve a light sinking cage and a double-drum model to handle two 70-cu. ft. buckets traveling in diagonally opposite corners of the shaft. Both hoists were placed to use the permanent sheaves.

Sinking of "A" shaft in the ledge started Sept. 17, 1951, with conventional methods, except that mucking was done with two ⅜-cu. yd. (later ½-yd.) hydraulically-operated clams. The shaft had reached a depth of 3198 ft. on July 31, 1953, which point is about 8 ft. below the floor of the 27th level.

During the shaft sinking and underground pre-development, a permanent engine house and a combination shop and warehouse-changehouse-office building have been under construction. The engine house is a 126 x 149-ft. steel, cement-block and brick structure housing two 750 v., d.c. double-drum hoists, one a 12-ft. dia. by 94-in. face, 1750-hp. cage hoist powered by a 1500-kw. synchronous motor-generator set, and the other a 15 ft. dia. by 98-in. face skip hoist driven by two 2250-hp. motors taking power from a 3500-kw. motor-generator set driven through a 60-ton flywheel. The skip hoist will be capable of handling 15-ton bottom-dump skips at a rope speed of 2400 fpm. In the same building will be three 600-hp., 4160 v., 3190-cfm air compressors with space for a fourth.

Full Production in 1955

Based on present progress, the completion of "A" shaft is indicated for the fall of 1953. Pocket construction and pump installation will be completed by mid-1954, permitting large-scale rock development on the lower levels immediately thereafter. It is currently expected that full production will be achieved by the end of 1955, 14 years after the inception of the exploration project.

Table 1. Improvements in Mill Performance Due to Decreased Ball Load

	NOW	BEFORE
Ball Load, tons	35	55
Ball Load, % volume	29%	45%
Tonnage	2250	2130
Horsepower Requirements	370	490
Ball Consumption, lb./ton	0.84	1.02
Grind: Sulphides—200 Mesh	65%	62%
Grind: Gangue—200 Mesh	35%	40%
Tails: Copper	0.068%	0.08%
Tails: Sulphur	2.5%	4.0%
Sod: Ethyl Xanthate, lb./ton	.28	.34

The Remarkable Case of the Copperhill Ball Mill

WHAT HAPPENED when the ball load in Tennessee Copper Co.'s huge Hardinge Tricone mill was reduced from 55 tons to 35 tons should give a lot of mill men food for thought. Not only did the reduced ball load make possible an increase in tonnage ground from 2130 to 2250, but power requirements dropped from 490 hp. to 370 hp. Nor was that all. As a result of the remarkable differential grind achieved (see table above), it has been possible to cut down on reagents.

Between August and October 1952 the amount of balls in the mill at Tennessee Copper's London plant was reduced from a load occupying 45% of the mill volume to a load occupying 29% of the mill volume. No other operating condition was changed. The mill turns over at 15 rpm (63% of critical speed), ball size is 1-in., average pulp density is 63% solids.

Results shown in Table I, were disclosed to a visiting *E&MJ* editor by Mr. F. M. Lewis, mill superintendent, who plans to experiment with further reduction in ball load in the near future. In addition to the lower ball consumption noted, it was possible to postpone an impending liner change because liner wear has been reduced.

Could the large classifying pool in this mill be contributing to these remarkable results? This pool has an area of about 70 sq. ft. and averages approximately 40-in. deep. The mill discharge is only 63% solids, but the material at the bottom of this pool, which must be the feed to the ball mass, is at least 75% solids. Also, this material is as clean as most conventional classifier sands. Thus only the coarse portion of the pulp in the mill, which has been thickened, ever enters the ball charge and in a very short time it is back in the mill pool for reclassifying.

Mr. Lewis doesn't know the answer at this time, but members of his staff are studying the conditions in their grinding circuit.

See *Engineering and Mining Journal*, June, 1953, pp. 86-89.

Copperhill

WE HAD INTENDED TO USE this space to record a majority opinion of the June and September contributors to the discussion, of Copperhill's improved ball mill practice as indicated at the left. The wide divergence of approaches to the problems, however, makes a tidy summation impossible. As a matter of fact, summing up isn't necessary. The real benefit of this discussion lies in the exploration of the problem. We feel that this kind of panel discussion is a step toward filling in the gaps in our knowledge of grinding. As Dr. Haultain puts it so aptly, "Groping may be an important engineering process."

H. R. BANKS
Consulting Engineer
Kimberley, B. C.

I WOULD LIKE TO GIVE YOU my reaction to the changes brought about by reducing the ball load in the Tricone Mill at the London plant.

1. Though not so marked as in this case, we have found an advantage in maintaining a ball load of say 47% instead of a higher percentage. We found it necessary to keep the load up to that approximate figure otherwise the grind would fall off.

2. I do not doubt that the classifying pool does play a prominent part in the amount of material finished in the mill.

When it comes to grinding I always refer back to the Muller and Bucking Board and the screen which removes the finished product. If we allow the full sample to remain on the Bucking Board too long between screenings we do tend to damp the action of the Muller.

The classifying pool with the current flowing down the gradient does remove the finished product and delivers the unground portion back to the ball charge in a similar way to the screen used for removing the finished material from the Bucking Board.

As the pulp flows out from the mill it is a mixture of the fines swept out on the classifying pool and the sands which are displaced

Story Stirs Thinking on Grinding

by new feed. The separation is made in the classifier.

If one could conceive of a stream of air being blown over the sample on the Bucking Board during the bucking action we would simulate the ball mill action since some of the finished product would be removed without waiting for the screening action.

3. The weight of the Muller is comparable to the ball load.

It would seem reasonable to assume that if the elimination of the fines could be improved, a lighter Muller might do just as much work as the heavier Muller damped by the inclusion of finished materials on the Bucking Board. The lighter Muller would in turn yield a differential grind just as the lighter ball load has done.

H. E. T. HAULTAIN
Consulting Engineer
Toronto, Canada

AS AN OLDTIMER I much appreciate the opportunity of joining with the younger millmen on the common ground of some of our ignorance of what really happens in a ball mill. I *am* an oldtimer. I was a millman in the Erzgebirge more than sixty years ago. Milling was my first love and with some lapses I have been loyal to her ever since.

It appears that Lewis has two new achievements to his credit. He has the unquestioned result of materially reducing his fine grinding costs and he has shown us that there is still much going on in a ball mill that we don't understand. This is a definite call for more experiment and more research and this, Mr. Editor, you have emphasized by encouraging us to confess our ignorance. Good work! I have not an answer to the problem, I have only some suggestions. But in such good company I venture to add a contribution based on work that Dyer and I did thirty years ago.

First let me explain my use of certain words. In this discussion I prefer to use *cracking* and *crushing* in place of grinding. We grind tons but we crack or crush particles. (My bow to Myers. I can crack an egg and crush an eggshell but how do you grind an egg?) I would stress attention to the particle and the idea that the nipping of the particle is an essential, the essential, in all crushing and grinding. I suggest that in the final analysis what Lewis has done was to increase the number of nips per ball. There is another word *cascading* that I want to use but my interpretation of it differs from that given to it so far in this discussion. For example Dorenfield suggests that "the Copperhill mill does not cataract." Has he a word for what it does do? What does Crocker want us to understand when he uses the words "as suitable a cascading action (or ball mill action)." At Niagara we have cascades and falls. These words are used by engineers as well as by others. In the cascades above the falls the water rolls. In the falls the water falls in a free parabolic path. In my discussion of our slow motion films I stressed the idea that there were four different forms of ball paths in the ordinary practise of those days in ball mills. In the upward motion the path was circular. In the downward motion there were two separate and distinct types of paths. (I think E. W. Davis will remember this.) A free falling in parabolic paths and other paths in which the balls rolled on each other. I referred to the rolling as cascading and I am obstinate enough to still think I was right. Right or wrong please let me use this interpretation in the present discussion. I also stressed the turbulent motion in the "toe" where the downward motion was reversed into the upward path. This was the zone of hard knocks where I thought most of the energy in the balls was expended and that it was where the larger particles of the feed of those days were cracked. Forgive this digression but the words, cracking, crushing, particles, nips and cascading are the important ones in my contribution.

In the Copperhill Mill all the balls are rolling and to some extent slipping on other balls and on the liners. Let us grope about this phase. (I have long maintained that groping may be an important engineering process.) If particles are present they are nipped and cracked or crushed. Yes and no. If too many are present they resist or cushion the effect. We can imagine a pulp so thick that there would be no nipping, or so thin that there were too few particles to be nipped. Hence the importance of a suitable density of pulp. Let us try to tie in the idea of particles being cracked or crushed by nip with Hardinge's theory of ball cycles. He says, " . . . consider operating with a mill at 50% ball load, those balls on the outer rim make two cycles per mill revolution. A mill at 25% ball loading would cause the same balls in the same location to drop four times per revolution." Ignoring the fact that in the Copperhill Mill no balls drop (some cascade!) and without being quite satisfied about their being exactly two cycles per mill revolution for a 50% load it does seem probable that his general theory is sound. Perhaps it can be stated thus; the total number of ball cycles per revolution is the same with all ball loads, within limits of course. Does not that mean, also, ball nips per minute? And if the particles are small enough it means particles cracked or crushed per minute and that means tons per day. That looks like a perfect answer to our major problem but the older research man knows from painful experience that when a result fits into theory too soon or too perfectly that is the time to be on one's guard and check and double check. Inside a ball mill there are so many variables that theories by themselves are well nigh useless but they are a spur and a guide to further experiment. This theory of the ball cycles and nips lends itself to experimenting with smaller mills, laboratory work where variables such as speed can be readily altered and controlled. It should be noted that the smaller the load the greater the speed that can be used without departing from the cascading (rolling) action. How I regret that age and circumstances prevent my tackling the laboratory phase of the problem.

D. H. FAIRCHILD
Mining & Metallurgical Engineer
Tucson, Arizona

FIRSTLY, I THINK it should be recognized that, usually, there are so many variables and uncontrolled or not-understood factors involved in many milling practices that the engineer may run afoul by the slip-stick or by drawing conclusions

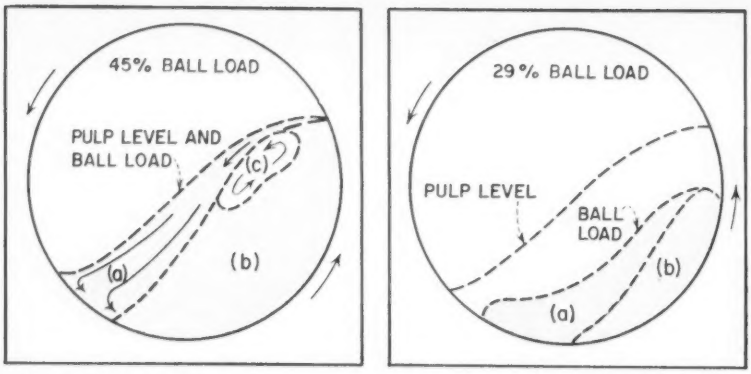


FIG. 1. Fairchild shows three zones when ball charge is large (left): (a) where most of the work is done; (b) less active; (c) kidney or "loblolly" where no work is done. At low ball charge (right), with dilute pulp, zone (c) disappears.

too hastily. Of the comments published in the June issue of *E&MJ* I feel that Mr. J. F. Myers has used good judgment in his reasoning, but possibly this is only a natural personal reaction since his and my theories roughly parallel each other.

Many years ago, a short time prior to the studies by Mr. H. E. T. Haultain and associates in Canada on what went on within operating ball mills, I had done considerable similar work. Our findings were closely parallel but, inasmuch as I was working on a private problem, I could not and did not publish my results. Motion pictures of glass-ended ball mills (taken by Pathe) disclosed a pattern that indicated two things quite clearly. The first that there are, roughly, three main zones or gradations of activity within ball mills. These "zones" are (Fig. 1) that region of cascading, falling or rolling action of the ball charge and ore across some substantial portion of the diameter as indicated by (a); The great mass of balls and ore that must be lifted by the rotation of the mill so they may cascade or roll or fall (b), and that zone so aptly referred to as the "kidney" or "loblolly" (c) where the balls seemed to eddy in a pattern that was kidney-shaped in cross-section, occasional balls escaping from this zone into one of the others. The value of these zones in terms of work done were felt to be in the order mentioned.

The second thing that was quite apparent was that, in the cylindrical (cross section) type of ball mill the maximum action possible for any given ball was 1½ actions per revolution of the mill. This was based, of course, upon what we felt to be the optimum condition at that time, namely a load of probably 45% volume so that the above-referred to zone (a) would be the greatest. Naturally, as one reduces the ball load (without ore or other "passing"), the activity of the remaining balls tends to rise as they are carried upward a shorter portion of the revolution before they cascade or roll. I feel that this would tend to be the situation in the Copperhill ball mill as it was operating on a "relatively dilute" pulp. Mr. Hardinge hit one of the nails on the head, in my opinion, when he commented that due to this dilution, the small charge of balls was permitted or caused to expend their work upon the unfinished material, which may be assumed as collecting low in that type of mill, with a high dilution of the pulp where the balls could act upon it. Mr. Lewis also mentions this.

Many years ago, in a large-scale test, I saw a ball load of from 11 to 14 tons occasionally do even more work in terms of finished product than 24 tons of balls were doing in the other mills. There were uncontrolled variables in this case that made results erratic and incomplete but there was no question about the results being comparable. Although ball mills, as they now stand, have been well developed and have given a good account of themselves, it is time for further basic developments in that art and those developments are, in my opinion, possible of fruition.

With possibly the single exception of the so-called "balanced" types of mills, there are fields for all of the main successful designs. The improvement must come from making better use of known factors. I feel that there are too many loose ends and unknown factors and variables in the Copperhill operation to draw definite conclusions. Certainly the indications are interesting and Mr. Lewis is to be commended for his attitude and his reluctance to jump to conclusions.

F. C. LENDRUM and G. PARE
Ascot Metals Corp., Ltd.
Sherbrooke, Quebec

WE ARE EXTREMELY INTERESTED in the reported increase in efficiency of the Tennessee Copper Corp.'s Tricone Mill when the ball load was reduced. Mr. Lewis is to be congratulated on his original work and for the speed with which he has spread the good news. You of the *Engineering and Mining Journal* are to be congratulated for gathering the opinions of so many mill operators.

We feel that your article will go a long way to free the ball mill from its present "convicts' status" of making little ones out of big ones, and put it in its true position as a conditioning agent for the process or processes that follow. We hope that other operators of small tonnage mills, who have not had the time or facilities to compute such things as "kilowatthourballs" in their grinding circuits, will contribute their ideas and experiences to this open discussion.

One of the writers had the opportunity to see this ball mill in operation in May of this year, and he was particularly impressed with the cascade action of the ball load. We believe that the increased performance as put forward by Mr. Lewis comes from two separate, though related, causes.

There is improved grinding of the sulphides with a coarser grinding of the gangue material because of this cascading action. This is an actual physical and mechanical process. In grinding a sulphide ore prior to flotation, we try to produce a product where the minerals are freed at the coarsest size. If a piece of ore is struck a sharp blow it will break along a plane or line of weakness, and crystal faces; or the interface between two minerals, which is a weaker plane than through the solid mineral. The cascading effect of the balls gives this sharp impact grinding.

In the work on grinding done at Ascot Metals, we found that if the ore was ground in an overflow type ball mill with conventional wave type liners, it was necessary to grind to 90% minus 200 mesh to liberate the minerals. In a low discharge, grate mill, using a liner

with a heavy lifter bar, liberation was complete at 65% minus 200 mesh. Gotte records similar experiences in his paper on the early work on the Tsumeb ore in South Africa.

The improved metallurgy is probably due in part to the low density of the mill, and the decrease in horsepower necessary to effect the grind. There is not enough data available to determine how much of the difference in horsepower formerly entered the picture as heat energy. It would be interesting to know if Mr. Lewis noted whether or not there was a decrease in temperature of the mill discharge after the change was made. Lower density should lower the temperature because the extra water will carry away heat. The decrease in horsepower and lower density should combine to make an appreciable change of temperature.

"Stray" chemical reactions that take place in grinding mills will increase their rates of reaction with an increase in temperature. The writers know of two mills, both treating copper-pyrite ores, that improved their metallurgy by lowering the density of the pulp in the ball mill to reduce the temperature of the pulp. In one case improved results were being had on night shift compared to day shift. The cause was traced back to a tired ball mill operator who always opened the ball mill water line to prevent the mill from plugging while he "rested". In the other plant it was found that with the coming of spring and warmer water, grade and recovery both fell off. The density of the mill was lowered and results became normal. Towards summer the condition became such that further lowering of the density (under 60% solids) affected grinding and, to keep the temperature down, the ball load was decreased. In the latter case it was noted that when the temperature of the mill was allowed to go up, the reducing power of the pulp increased, grade fell off, recovery of the copper was lower, and excess reagents had little or no effect on the situation.

We have always had difficulty in correlating the grinding data published by the gold mill operator, where he is grinding for the dissolution of gold by cyanidation, and data supplied by the base metal operator who is grinding as a means of liberating a mineral particle so that it may be physically lifted out of the circuit. It appears to us that when grinding for cyanidation, one should strive for the maximum of attrition which will cause the solvent to act on the freshly ground faces and at the same time spend any excess energy in the form of heat to increase the rate of reaction. This is the antithesis of grinding for flotation, of sulphide ores, where the ideal condition would be to have all minerals separated at their maximum size, and their surfaces conditioned to float only when wanted. Real confusion starts when efficiency is expressed in terms of dollars recovered, per ton of ore treated, by the processes that follow.

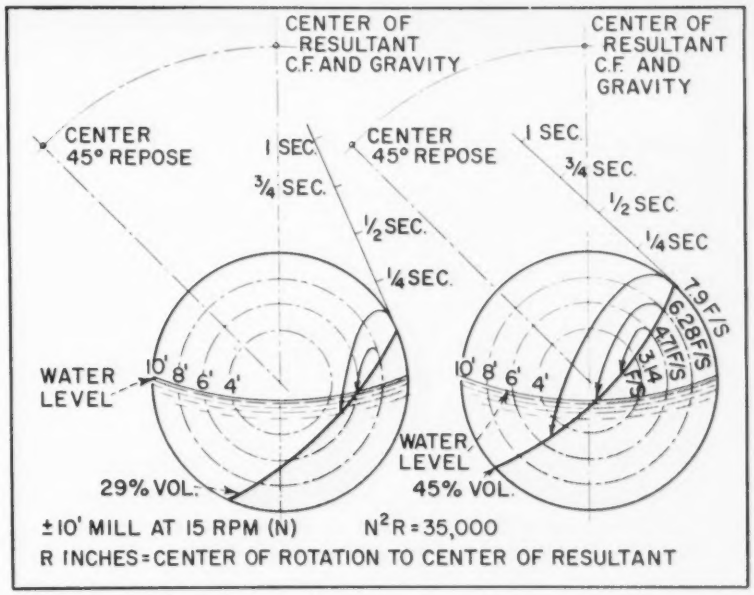


FIG. 2. Gates calculates theoretical ball paths and indicates that improvement in performance is due to the marked difference in ball action.

A. O. GATES
Utility Engineers, Inc.
Salt Lake City, Utah

THE DIAGRAMS (Fig. 2, above) of the conditions inside the ball mill at Copperhill are my contribution to the discussion of grinding at Copperhill. They show a marked difference in the falling ball action.

Of course the approximation of a 45-deg. angle of repose for the balls is arbitrary; a smaller angle would make less drop to the balls, and vice-versa, but the difference would still be marked.

The formula, N^2R equals 35000, where N is rpm and R is radius in inches measured from mill center to the center of the resultant forces acting upon the material in the horizontal rotating cylinder, comes from making centrifugal force equal to the force of gravity in the units of ball mill practice.

Critical Speed is taken as that of the shell of the mill; by the above formula for 10-ft. diameter it would be about 24.1 rpm, and 63% of critical figures at 15.2 rpm which is a good enough check on the assumption that it is a 10-ft. mill at 15 rpm. Of course the real critical speed should be taken inside the liner and at the center of the average ball against the liner. Due to wear variations however, that is impractical and is not absolutely necessary when there are other variables unmeasured like the slipping of the balls on the liner and each other.

The water levels are swung from the resultant center which makes the forces against the surface equal at all points when the mill is rotating; probably it would rise slightly on the right.

For any further guesses, it would be nice to see the screen analysis of the feed and the products given only as 200 mesh: say at least five values split around the 200 mesh.

L. E. DJINGHEUZIAN
Department of Mines
Ottawa, Ontario

MR. F. M. LEWIS MUST BE CONGRATulated on the remarkable results obtained from his experiments. There is very little doubt in my mind that

(Continued on p. 202)

Table I—Chemical Reactions in Ammonia, Ammonium Carbonate Leaching

LEACHING

Smithsonite: $ZnCO_3 + n\ NH_4OH \rightarrow Zn(NH_3)nCO_3 + n\ H_2O$

Hydrozincite: $2ZnCO_3 \cdot 3Zn(OH)_2 + 14NH_4OH + 3(NH_4)_2CO_3 \rightarrow 5Zn(NH_3)_4CO_3 + 20H_2O$

Calamine: $H_2Zn_2SiO_5 + 4NH_4OH + 2(NH_4)_2CO_3 \rightarrow 2Zn(NH_3)_4CO_3 + H_2O \cdot SiO_2 + 6H_2O$

$$H_2O \downarrow + SiO_2$$

Zinc Oxide: $ZnO + 2NH_4OH + (NH_4)_2CO_3 \rightarrow Zn(NH_3)_4CO_3 + 3H_2O$

Malachite: $CuCO_3 \cdot Cu(OH)_2 + 6NH_4OH + (NH_4)_2CO_3 \rightarrow 2Cu(NH_3)_4CO_3 + 8H_2O$

Siderite: $FeCO_3 + (NH_4)_2CO_3 \leftrightarrows FeCO_3 \cdot (NH_4)_2CO_3$

Note: Not more than about 1g. Fe per liter has been found in any of the test solutions and generally the amount is undeterminable.

PURIFICATION

Iron: $4\ FeCO_3 \cdot (NH_4)_2CO_3 + O_2 + 2H_2O + 8NH_4OH \rightarrow 4Fe(OH)_3 + 8(NH_4)_2CO_3$

Copper and other metals: $Cu(NH_3)_4CO_3 + Zn \rightarrow Zn(NH_3)_4CO_3 + Cu$

PRECIPITATION AND SOLVENT REGENERATION

Ammonium Carbonate: $(NH_4)_2CO_3 + H_2O \xrightarrow{\text{(heat)}} 2NH_4OH + CO_2$

Zinc Ammonia Complex: $5Zn(NH_3)_4CO_3 + 3H_2O \xrightarrow{\text{(heat)}} 2ZnCO_3 \cdot 3Zn(OH)_2 + 20NH_3 + 3CO_2$

These Formulas Point the Way to a New Process for . . .

Ammonia; Ammonium Carbonate Leaching of Low Grade Zinc Ores

WILLIAM J. WENDT
Baker, Oregon

MILLIONS OF TONS of low grade oxidized zinc ore are now going to waste or lying unexploited in many of the mining areas of the world for lack of a suitable treatment process. Often these ores are earthy and admixed with clay or iron oxides in such an unimpressive way as to easily escape attention. Principal oxidized zinc minerals in these ores are Smithsonite ($ZnCO_3$), Hydrozincite ($2ZnCO_3 \cdot 3Zn(OH)_2$) and Calamine ($H_2Zn_2SiO_5$). Deposits are limited in size: However many are known which contain millions of tons of ore.

None of the oxidized zinc minerals lend themselves very readily to any known concentrating method. Their specific gravity is too low for good gravity separations and although many other carbonate and silicate minerals have yielded to concentration by flotation, the results along this line have not been successful with oxidized zinc ores. Often all three minerals are simultaneously present in a single ore sample and though one mineral generally predominates, the zinc from all three must be extracted if a high overall recovery is to be obtained. Along this line it should also be noted that although smithsonite may be the principal mineral in one part of a large ore body, hydrozincite or calamine may predominate in some other part. This further complication limits the chances of working out a successful concentrating method. In view of these conditions, a hydro-metallurgical process would seem to offer a reasonable solution to the problem if a suitable solvent were available.

Since these ores generally occur in association with a limestone gangue, no acid leaching process is possible. Several other solvents exist but one consisting of ammonia and ammonium carbonate seems to possess the most desirable combination of properties. Some of these desirable solvent properties of ammonia, ammonium carbonate solutions are listed below:

1. It acts selectively on the ore minerals.
2. The precipitation method is simple and economical.
3. The solvent is easily and completely regenerated.

4. The solvent is capable of carrying high concentrations of metal ion in solution.

5. Ammonia losses from all causes will be slight and are not a major economic factor in the process.

6. There is little chance for impurity build-ups in the solution to occur.

7. The small amounts of impurities which do enter the solution can be removed prior to precipitation if a product of extreme purity is desired.

8. Other metals such as copper and cadmium which form soluble ammonia complexes can be recovered as a separate product.

9. No problems in disposing of dilute wash solutions are encountered as the only solutions run to waste contain only insignificant traces of metal ion or solvent.

10. The nature of the solvent makes filtration relatively easy.

11. The water requirement for the process is very small.

12. Corrosion of processing equipment is not a significant factor if proper materials are used and fortunately these materials are not expensive.

Chemistry of the Process

Chemical reactions (Table I) show briefly the chemistry of the process. Presently accepted general theories of complex ion formation assign to zinc a coordination number of four in ammonia solutions. In all of the reactions except that with smithsonite, zinc is empirically shown coordinated in this way in order to simplify the equations. Test data indicates that the *average* coordination number for zinc in the leach solutions may be at least as low as 2.9. Very probably a whole series of complex ions exist in solution simultaneously which range from $Zn(NH_3)^{++}$ to $Zn(NH_3)_4^{++}$ and possibly to $Zn(NH_3)_6^{++}$. In the tests which investigated the upper concentration limits, practical equilibrium only was reached as evidenced by the fact that the zinc concentration of the solutions was still very slowly increasing at the end of 48 hours. The average coordination number seems to be definitely related to the ammonia concentration. Thus, in a solution carrying about 40g. of NH_3 per liter, the average coordination number appears to be about four, while in a solution carrying 120g. of NH_3 per liter, the average number is 2.9 or lower. The work with smithsonite has definitely established that for each mole of zinc in solution, there must also be one mole of CO_2 for the anion of the complex. The zinc concentrations obtained in plant solutions will, for practical reasons, never reach saturation. Because of this and the limits of time and facilities, the problem has been investigated more from the practical rather than the academic point of view.

Silica to the extent of about 2g. per liter may be found in the solutions obtained from leaching calamine. By proper control of conditions, any harmful effects this may have on the reaction or on the contamination of the final product can be prevented. This amount of silica does not have any noticeable effect on the filtration rate.

The mineral siderite ($FeCO_3$) is slightly soluble in carbonate solutions. Water saturated with CO_2 at 20 deg. C. will hold about 1g. of ferrous iron per liter. It is to be noted that CO_2 is the solvent in this case for iron rather than ammonia. A complex ion is formed in which iron is held within the complex and is not itself freely ionized. One method of causing the iron to precipitate is to thoroughly aerate the solution. The ferrous iron will be oxidized to the ferric state in which form it will precipitate as ferric hydroxide.

Purification of Solutions

Purification of the pregnant solutions will generally not be necessary if the final product is to be used for the production of metallic zinc. When a high quality product is desired or a by-product such as copper is to be recovered, purification of the solutions is required. From properly purified solutions, it is possible to precipitate an extremely pure product which should be directly saleable to the chemical, paint, or drug industries.

Copper and cadmium minerals are dissolved with the zinc. Nickel and cobalt, if present in the proper chemical combination, are also soluble. Metals below zinc in the electrochemical series such as Cu, Cd, Ni, Co, Pb, and Ag may be precipitated from solution by metallic zinc. This metal can be some form of zinc scrap. Dross skimmed from the furnaces in which zinc is melted should make an excellent precipitant.

Analysis of a typical final product reveals 60.2% zinc content, 300 ppm. magnesium and 0.36% silicon as SiO_2.

When solutions are not purified, the lead content of the final product may be about 500 ppm (parts per million). This is reduced to spectographically undeterminable amount by the metallic zinc purification. About 200 ppm of iron is generally found in the product prepared from unpurified solutions. This amount of iron gives the otherwise pure white product a slight creamy color.

Precipitation of Zinc

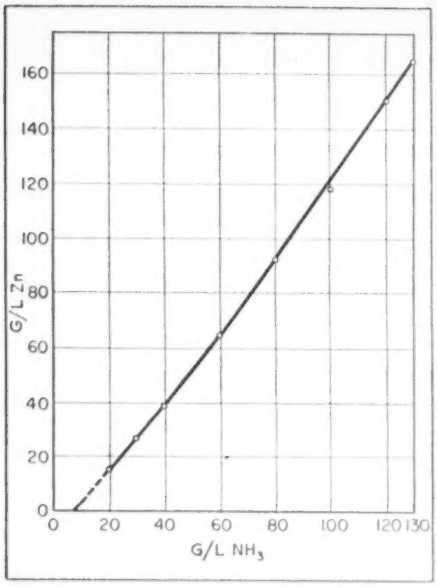
Precipitation of the zinc from solution is carried out by boiling and hydrolysis. This same precipitation method is followed when leaching copper and nickel ores with ammonia. The equations shown are strictly empirical but can be considered as the sum of all the reversible step reactions that take place. The composition of the basic zinc carbonate product is somewhat variable depending on the conditions of precipitation and the temperature at which it is dried before analysis. Drying for any length of time at a temperature above 125 deg. C. drives off the water present as hydroxide. By heating the product at a temperature above 300 deg. C. both water and CO_2 are removed and the material is converted to zinc oxide which carries approximately 80% zinc.

When the solutions are boiled, the first gases coming from the still are largely CO_2 and advantage may be taken of this to eliminate excess CO_2 from the solutions. When treating ores in which more than about two-fifths of the oxide zinc is present as zinc carbonate, a build-up of CO_2 in the leach solution would occur if part of the CO_2 were not removed.

With a relatively low priced metal like zinc, it is necessary for economical operation that high zinc recovery be made in the smallest possible volume of rich solution. Since all the oxide zinc is potentially recoverable, much of the experimental work has been specifically concerned with methods of obtaining rich solutions.

Experimental Curves

The data shown on the graphs is presented only as a guide for future work. It has not been sub-



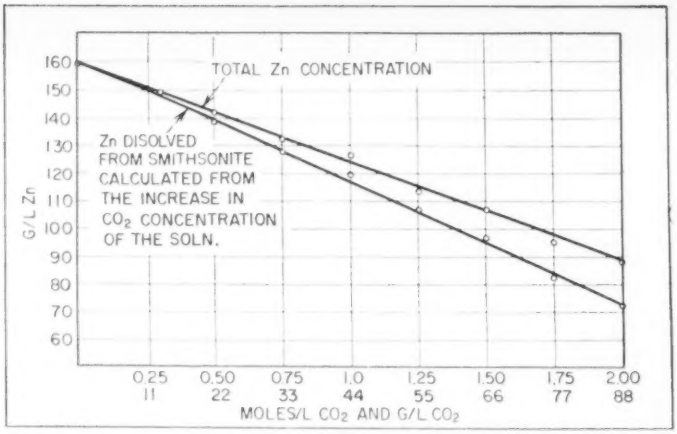


FIG. 2. How CO_2 concentration affects the solubility of zinc in high grade smithsonite. Volume of NH_3 was 120 g per liter; time 18 hr. Zinc as oxide, 50.9%; as carbonate, 47.5%.

FIG. 1. How NH_3 concentration affects solubility of zinc in high grade smithsonite at room temperature, atmospheric pressure.

jected to statistical analysis and the experimental error was not determined. Some of the data was gathered while test procedures and analytical techniques were still being revised. The data does show the type of result that can be expected and is useful in a practical approach to the problem. It was not assembled for the purpose of proving any exact chemical laws dealing with complex ions.

The first three graphs were prepared from tests made on high grade smithsonite from Stevens County, Washington. In all of these an excess of ore was present in the pulp during the test. Fig. 1 shows the influence ammonia concentration has on the zinc content of the solutions. It is to be noted that the data does not quite plot as a straight line relationship. At the higher ammonia concentrations the number of moles of ammonia required to hold one mole of zinc in solution is smaller. Ammonia concentrations below about 60g. NH_3 per liter do not produce zinc solutions rich enough for economical precipitation. For practical operational reasons the ammonia concentrations should not exceed 130 to 140g. per liter. In ammonia leaching of metallic copper and nickel, oxygen is necessary for the reaction and the solutions must be aerated. Air agitation is used in nickel leaching and much ammonia is removed from solution by the vapors leaving the agitators. The ammonia concentration of the rich nickel solutions sent to precipitation average between 5 and 6% NH_3, while the solution in the first agitator carries 7 to 8% NH_3. Large scrubber units are necessary to recover ammonia from the vapors leaving the agitators. Many of the complications present in nickel leaching are not encountered in zinc leaching and since oxygen is not required for solution of the zinc minerals, the benefits of stronger ammonia solutions may be realized.

Effect of CO_2

The effect of CO_2 on the zinc concentration of the solution obtained from leaching zinc carbonate is shown in Fig. 2. This data shows that for each mole of CO_2 present in the leach solution at the start of a test, the potential extractive power of the solvent for zinc carbonate is reduced roughly 0.65 of a mole of zinc per liter. Some non-carbonate zinc present in the ore was extracted because of the CO_2 in the solvent. Thus, the lower curve calculated from the CO_2 increase of the solutions presents a more accurate picture of this effect.

Both the zinc and CO_2 concentrations of the final solutions are shown in Fig. 3. By calculating the moles of zinc and CO_2 present in any of the solutions, it can easily be seen that both zinc and CO_2 exist in solution on an equimolar basis.

Fig. 4 was prepared to find the optimum amount of CO_2 that should be present in the leach solutions when treating non-carbonate ores. Calamine ore associated with a gangue consisting mainly of limonite and silica was used in these tests. This ore came from the vicinity of the Reeves MacDonald property near the border of southern British Columbia and northern Washington and is the only material examined which was predominately calamine. No zinc at all is dissolved from the material unless some ammonium carbonate is present. The data shows that the most desirable solvent for non-carbonate zinc minerals contains 3 to 3.5 moles of NH_3 per mole of CO_2. Note that the zinc concentrations derived from single stage leaching on this material are not nearly as high as those obtained when treating high grade smithsonite. This is probably because an equilibrium is established between the zinc in solution, the soluble silica, and the insoluble residue. Solutions with sufficient concentration of zinc for economical precipitation can be obtained without resorting to special procedures, however much higher concentrations are possible.

Fig. 5 was prepared from single stage leaching tests on a mixed ore to get some idea of the effect of CO_2 concentration. This ore came from the oxidized zone of the Josephine orebody near Metaline Falls, Washington, and contained 3.8% carbonate zinc and 1.7% soluble non-carbonate zinc. Data of this type obtained from single

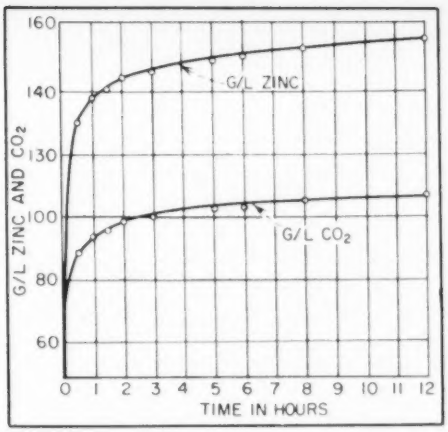


FIG. 3. How time affects zinc solubility on high grade smithsonite.

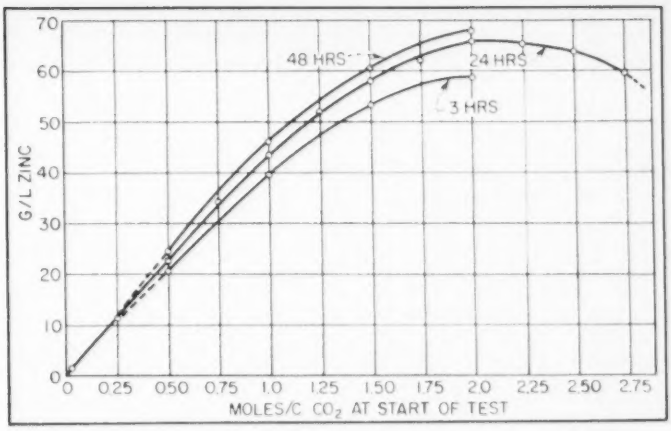


FIG. 4. How CO_2 concentration affected zinc solubility in a calamine ore in single stage leaching for different periods of time.

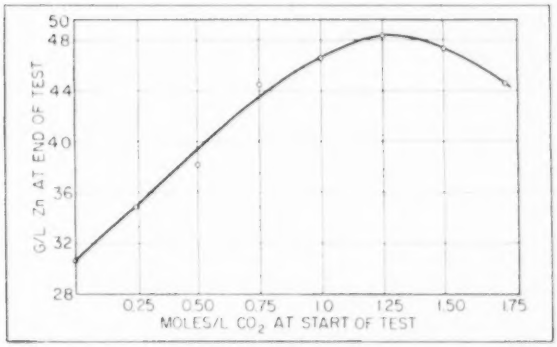


FIG. 5. How CO_2 concentration affected zinc solubility in single stage leaching of Josephine ore.

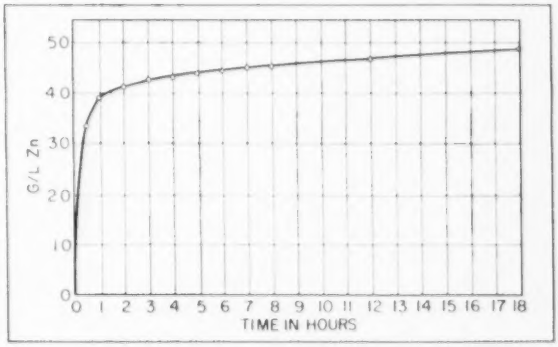


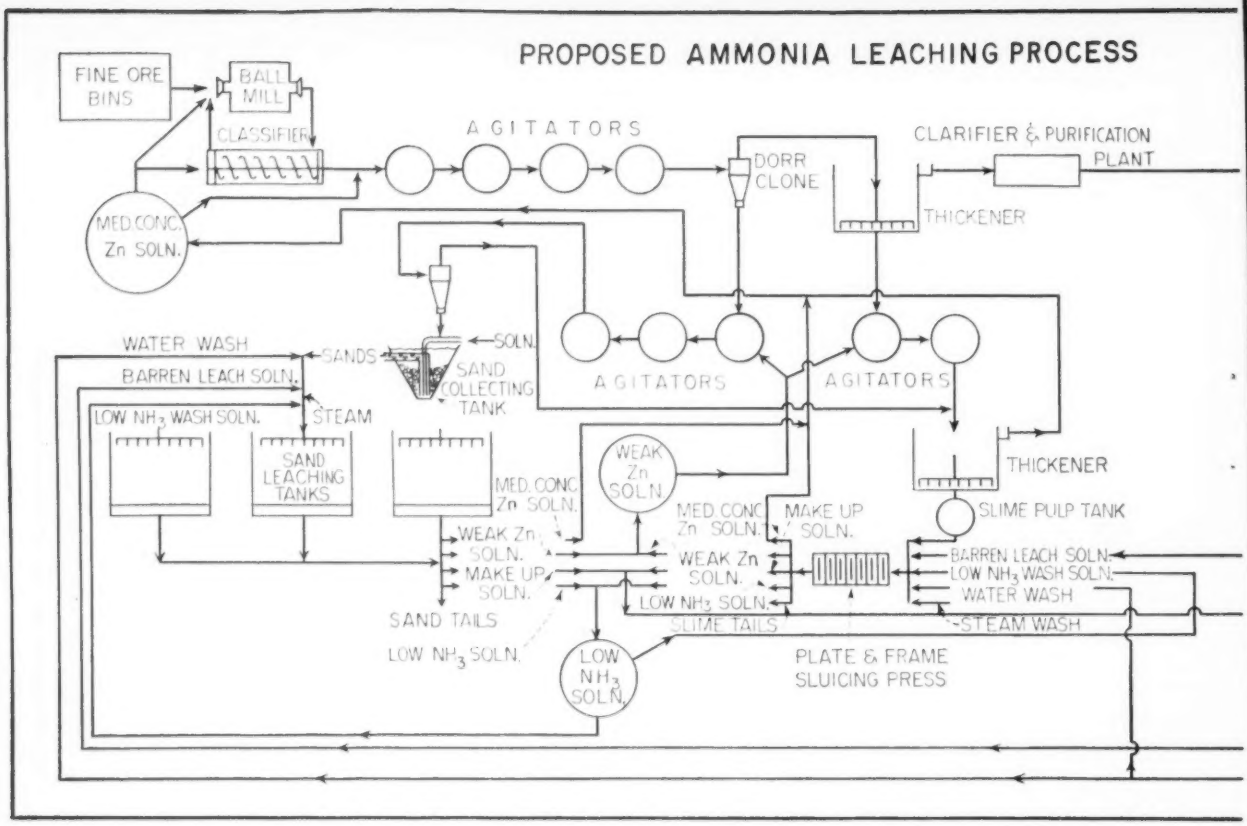
FIG. 6. How time affected zinc solubility of Josephine oxide ores in single stage leaching.

stage leaching of an ore containing several minerals is only useful as a very rough guide since the minerals are not dissolved at equal rates or recovered in equal amounts. When no CO_2 is present, only carbonate zinc is dissolved. At the CO_2 concentrations beyond the peak of the curve, the amount of carbonate zinc dissolved is greatly decreased while the amount of non-carbonate zinc in solution is increased. The best starting CO_2 concentration for leaching mixed ores is the one which will produce the most complete recovery of both metals in the smallest volume of rich solution. To determine this requires considerable testing and can only be proven in continuous tests approaching pilot plant operations.

Dissolution rate, as evidenced by the increase in zinc concentration of the solutions with time, is shown in Fig. 3 and Fig. 6. Curves at several different time intervals shown in Fig. 4 are also of interest along this line. Whenever ore and solution are brought together, the reaction is at first very rapid. About 80% of the zinc found in solution after 48 hours is dissolved in less than 30 minutes. This has been found to be approximately true, regardless of the type or grade of ore, amount of excess ore present, fineness of grinding, or reagent concentrations. After this initial period, the reaction proceeds very slowly even though the extraction is not complete and the solutions are far from saturated. Although mass action may be the major factor influencing dissolution rate, other possibilities such as the formation of intermediate compounds are suggested by the abrupt change in slope of the extraction curves.

The data shown graphically was prepared from single stage leaching. With low grade material such as that used for the tests shown in Fig. 6, the zinc concentrations thus obtained are generally somewhat low for economical precipitation. When solution partially concentrated in zinc is brought in contact with fresh ore or partially leached residue is pulped up with fresh solution, the initial dissolution rate is again rapid.

By stage or countercurrent leaching, it has been found possible to get a very high recovery in a relatively small volume of rich solutions. Using this method, barren solution extracts the last of the metal from the residue and then passes by successive stages to richer material until it finally meets fresh ore where the zinc concentration is built up to the desired amount. The final solutions from countercurrent or stage leaching on low grade material contain more zinc than can be dissolved by single stage leaching even with a great excess of ore present. Small scale test plant work using several stages of leaching was performed in order to investigate both recovery and solution concentration on low grade material. Using this system on Josephine ore from which curves in Fig. 5 and Fig. 6 were prepared, it was found that solution



concentrations of 80g. per liter could be built up easily in three stages with a zinc recovery of over 95%. The actual contact time between ore and leach solution need not exceed 12 hours when using agitation leaching.

When preparing ores for leaching, the high degree of liberation of the ore mineral particles required for concentrating operations is not necessary. Only a small area of the surface of a mineral particle need be exposed to the lixiviant for the mineral to be dissolved. In practical operations an economic balance naturally exists between particle size, extraction time, and recovery for the chosen method of treatment. Most of the oxidized zinc ores examined have been rather porous with the zinc minerals covering the surface of cavities or occurring as large masses. The zinc minerals in such materials can be exposed to the action of the solutions without resorting to fine grinding. Analysis of residues from test plant work using agitation leaching show little difference in zinc content of the various size fractions from 20 mesh down to 325 mesh. When using a leaching system such as that shown on the flowsheet, grinding to about 20 mesh should be sufficient for good extraction on most ores. Each ore must, however, be considered as a distinct individual and pilot plant work on the effects of particle size and all the other variables would, of course, be necessary before making any specific recommendations.

Potential Flowsheet

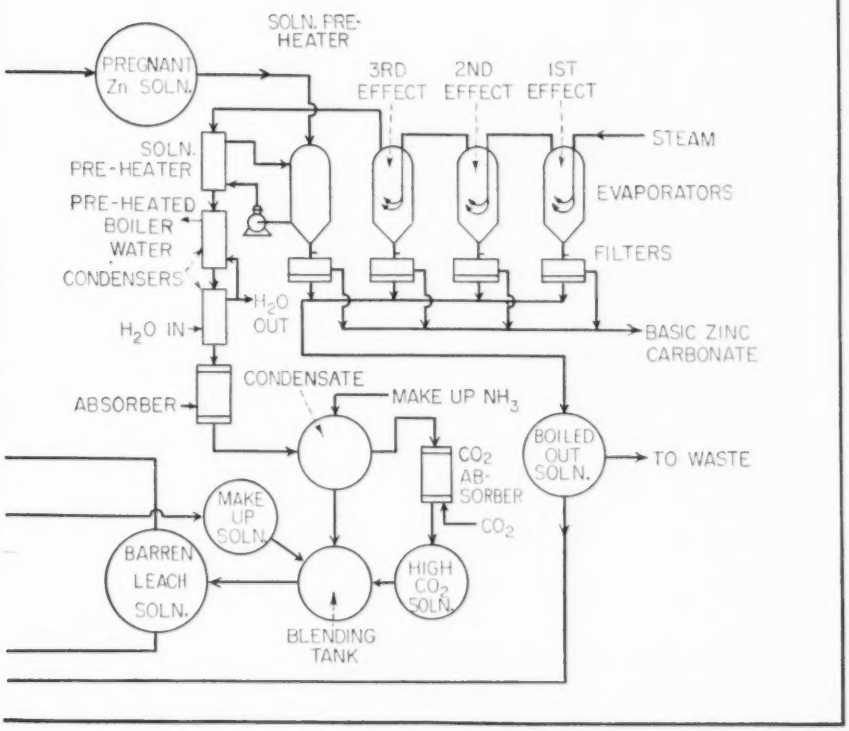
The accompanying flowsheet was prepared in order to show one method of applying ammonia, ammonium carbonate leaching to an oxidized zinc ore. The particular ore considered averages over 5% oxide zinc, much of which is present in a non-carbonate form. Grinding through 20 mesh produces about 20% of minus 325 mesh material. The minus 325 mesh sand-slime pulp filters without much difficulty even when a rather thick filter cake is formed. The deslimed sand should be easily handled in 10-ft. deep filter-bottom percolation leaching tanks similar to those used in treating copper ores. The flowsheet has not as yet been tested on a continuous pilot plant basis, however enough small test plant work has been done to indicate its feasibility.

The leaching system envisions the following features:

1. A countercurrent leaching system capable of producing rich solutions and practically complete oxide zinc recovery.
2. A partial batch method of handling which allows enough flexibility in the circuit to accommodate unexpected feed variations.
3. Grinding the ore in leach solution.
4. Agitation during solution concentration stage of leaching.
5. Two stage separation of sands and slimes by an inexpensive method.
6. Separate treatment of sands and slimes during the finishing stages of leaching by methods more suited to each material.
7. Filtration and washing of the sand fraction, which makes up the major portion of the pulp, in deep filter-bottom leaching tanks at relatively small expense.
8. Filtration and washing of the slime fraction in self-sluicing plate and frame filter presses.

Recovery of ammonia from the ore residue is one of the most important factors influencing the

FOR OXIDIZED ZINC ORES



success of any ammonia leaching process. Ammonia has a tendency to become adsorbed by the ore in such a way that it is very difficult to wash out with water alone even though very large volumes are used. Thus, the steam wash is absolutely essential for recovery of the solvent.

A system similar to that used in copper leaching is proposed for washing the sand fraction. Following the barren leach solution, low NH_3 wash solution made up from the water and steam wash on a previous charge, is drained through the sand bed under a low vacuum. The effluent from this is used as make-up solution in the blending plant for diluting the rich ammonia condensate. A warm water wash using part of the boiled out solution from the evaporators is next run through the charge. Following this, steam at atmospheric pressure is turned into the top of the sand tanks and drawn through the charge. Steaming is continued until the ammonia concentration of the effluent has been reduced to the economic limit. By running a small amount of waste hot water onto the sands following the steam wash and increasing the vacuum beneath the sand tanks, a small reduction in steam consumption can be achieved. This and other modifications in technique can be worked out in plant operations.

The washing procedure on the fine-sand slime fraction will be similar to that used on the coarse sands except the wash will be applied in enclosed filters, such as plate and frame filter presses. If ores are encountered which produce unfilterable slime pulps a system similar to that used in nickel leaching at Nicaro, Cuba, may be resorted to. The pulp is first washed free of metal values by countercurrent decantation. The dense pulp from the last thickener passes to a unit in which it is boiled until all the ammonia is vaporized. The vapors pass into a condenser system and the rich ammonia condensate is returned to the leaching circuit.

A careful solution balance will have to be maintained throughout the entire plant. For each ton of rich solution sent to precipitation, roughly one-half ton of water can be eliminated from the plant circuit as boiled out solution from the evaporators. This water may be made up from moisture in the ore, wash water, condensed steam wash, and water from the ammonia scrubbers.

A batch precipitation system using multiple effect evaporators is more suitable than a continuous precipitation system when treating carbonate ores. If the ore mineral dissolved is predominantly $ZnCO_3$ and the final product is a basic carbonate, a build-up of CO_2 in the leach solution would occur if part of it were not removed. As previously mentioned, the first gases coming from the stills when a fresh batch of solution is heated, are largely CO_2. By cooling these gases and passing them through a scrubber to recover ammonia, the excess CO_2 can be vented to waste, thus preventing a build-up in the solution. With a continuous distillation system such as that used when treating nickel or native copper ores, the composition of the gases leaving the stills is practically constant and CO_2 removal is not possible. Since some of the ore under study contained less than the desired ratio of carbonate to total soluble zinc, CO_2 would at times have to be added to the leach solution. CO_2 gas for the absorber unit shown on the flowsheet could be obtained either from a small coke burner or waste stack gases from the heating plant. Plants handling both carbonate and non-carbonate zinc ores will have to be designed so that CO_2 can be either added to the solution or vented to waste.

Precipitation System

The precipitation system shown on the flowsheet is patterned after that used at Kennecott, Alaska, for treating carbonate copper ores. With this system, live steam from the boilers is turned directly into the solution in the first effect tank. Vapor from the first effect evaporator passes into the solution in the second unit and that from the second into the third and so on. On the flowsheet the solution in the fourth evaporator is shown being pre-heated through a heat exchanger by vapors from the third effect evaporator as they pass into the condenser system. When the ammonia concentration of the solution in the first effect evaporator has been reduced to the economic limit, steam is turned into the second unit which then becomes first effect and the solution in the pre-heater unit goes on last effect.

The boiled out solution coming from the first unit carrying basic zinc carbonate in suspension is

filtered through a batch filter connected to the bottom of the unit. The warm precipitate may be partially dried by vacuum on the filter before further processing. Part of the hot filtrate may be used for wash water in the ore residue filtration plant. Some of its heat content can thus be utilized to warm the residue before applying the steam wash.

No difficulties have been encountered in recovering ammonia from solution by distillation. Some ores may be found which contain large amounts of soluble sulphates which might fix ammonia as ammonium sulphate. If trouble of this type develops, a base like lime can be added to the solution to release ammonia.

By increasing the number of evaporators in the series, the efficiency of the system can be made to approach that of the more efficient column stills and the ammonia concentration of the condensate can also be increased. The number of evaporators to be used in a series depends, of course, on the conditions under which they are to operate and is a problem in chemical engineering design.

Construction Materials

The physical and chemical properties of the solvent play a major part in influencing flowsheet design and the choice of construction materials. The following notes should be given consideration in the choice of materials. All copper and zinc base alloys are severely attacked by any contact with the leach solutions or any moist vapors carrying ammonia. Steel and cast iron are not appreciably corroded by the leach solutions. In the copper leaching plants, some corrosion of the steel tanks holding the high grade ammonia condensate from the stills was noticed, so these units were lined with concrete. All heat exchanger parts in the condenser system can be made of pure aluminum. No aluminum alloys containing copper are suitable for this as they are severely corroded. In any pilot plant test work the corrosion problem should be given additional study.

The somewhat volatile nature of the solvent makes it necessary to keep all units in the plant covered or enclosed. Any open tanks or launders would allow some loss of ammonia and make working conditions uncomfortable. With properly designed equipment, no significant ammonia losses should occur through volatilization.

Probable Operating Costs

One of the major cost items in the process will be for the steam used in the precipitation plant and for washing the ore residue. The best source of data at the present moment on consumption of process steam is contained in the published literature on copper leaching with ammonia. Data from the Kennecott, Alaska, operation is probably more directly comparable, since the system that was used there is similar to that proposed for treating zinc ores. Small scale test plant work indicated that this data is usable for preliminary calculations.

Steam consumption in the precipitation plant will be roughly 500 kg. of steam per cubic meter of solution sent to precipitation. With a 5% ore producing solution carrying 70 to 80g. of zinc per liter, about 0.7 of a cubic meter of rich solution will be produced per metric ton of ore and about 350 kg. of steam will be required in the precipitation plant. The steam wash will require another 50 kg. of steam per ton of ore. Thus, total steam consumption per metric ton of ore should be about 400 kg. With lower grade ores producing about the same grade of zinc solutions a correspondingly smaller amount of steam will be required.

Recent steam cost figures available in the literature on industrial installations range between 30 and 70¢ per one thousand pounds. A steam cost of 55¢ per thousand is probably a reasonable figure for rough calculations. On this basis, the cost of the process steam would be a little less than 50¢ per ton.

In a properly designed plant ammonia losses from all causes should not exceed one pound per ton of ore treated. After the technique of steam washing was perfected at the Kennecott plant, ammonia losses ranged between 0.45 and 0.6 lb. per ton of ore. Published data on nickel leaching at Nicaro indicates that ammonia consumption there is a little over one lb. per ton. This would seem to be very good considering the unfilterable nature of the tailings pulp.

Ammonia in tank-car lots delivered at railheads in the U. S. should not cost more than about 5¢ per lb. Thus, ammonia losses should not add more than 5¢ per ton to the cost of processing.

It is very difficult to predict without extensive pilot plant work what the total operating cost for leaching oxidized zinc ores will be. Mr. Duggan gives some figures on oxide copper leaching at Kennecott in the references listed at the end of this article which indicate that treatment costs, when handling 19,000 tons of ore per month during the middle 1920s, were about 57¢ per ton. Although this figure is interesting, only the basic data on consumption of such things as steam, ammonia, power, and labor should be used in preliminary calculations of present day costs. Estimates of the operating cost in treating the 5% oxide zinc ore previously mentioned, at a rate in excess of 500 tons per day by the method shown on the flowsheet, range between two and three dollars per ton.

Plant investment costs are another thing which it would be difficult to estimate at the present time. With a flowsheet such as that shown, the cost would probably be several thousand dollars per ton of daily capacity. To amortize this rather heavy capital investment, a very large proven ore reserve would be necessary.

Acknowledgements

I wish to express my gratitude to the Institute of Technology, Washington State College, in whose laboratories I have, until recently, been able to carry on this work, and to the Pend Oreille, Reeves MacDonald and other mining companies in the area who have furnished me with ore samples.

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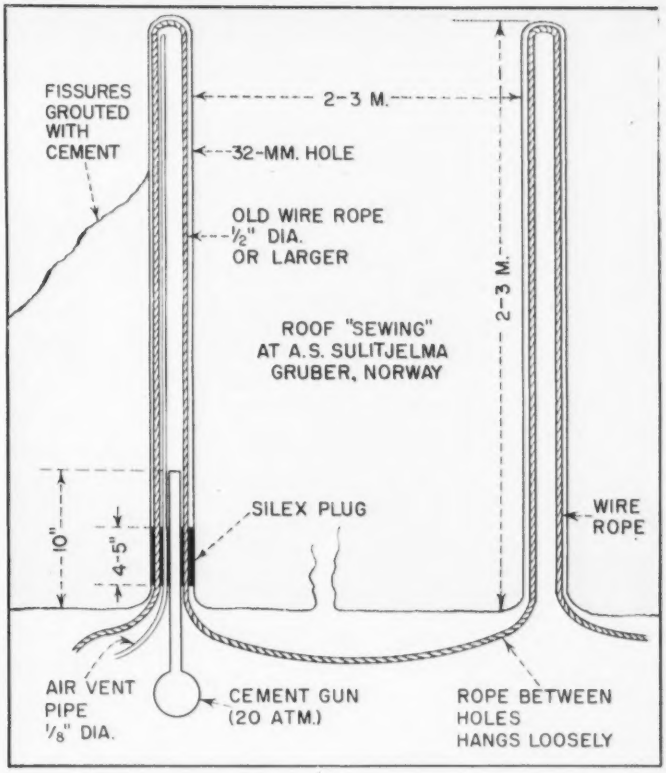
'Roof Sewing'

This unique ground support method, similar in function to roof bolting, was devised at the Sulitjelma Mine in Norway. C. C. Austin, retired general manager of the Mancha Division, Goodman Manufacturing Co., who recently toured Norwegian mining areas, describes this idea for *E&MJ* readers.

C. C. AUSTIN, recent American visitor at the Sulitjelma mine and other Norwegian properties.

EINAR TRÖFTEN chief mine engineer who devised the "roof sewing" technique as shown at right.



ROOF SEWING involves these steps: (1) Drill hole 2 to 3 m. deep. (2) Insert wire rope. (3) Insert vent pipe. (4) Insert short pipe connected to grouting pump. (5) Insert Silex plug. (6) Grout hole with concrete gun at 300 lb. pressure.

DID YOU EVER HEAR of sewing a roof in place? Neither did I until I came to Norway.

The ore at A/S Sulitjelma Gruber mine at Sulitjelma is 1 to 2 m. thick, roughly horizontal on the strike 400 to 600 m. wide with a dip from 10 to 50 deg. and lies under a laminated schist top.

That part of the vein dipping 10 to 35 deg. is mined by scrapers working on a long face which closely resembles long wall coal mining. Cribbed pillars of schist blocks are used to support the top and conventional split end bolts with wedges are used also to support the top. This method has been used for 20 years in various places and is now being used in the stopes.

Two methods, both the same in principle, are used where the top is particularly dangerous and where the conventional bolt is insufficient.

The roof is hung on wire rope and the miners call it "sewing the roof."

The attached diagram shows the method in detail. Holes 32 mm. in diameter are drilled at 2 to 3 m. into the top and ½-in. wire rope loop is pushed to the top of the hole. The rope extends to the next hole 2 or 3 m. away and the wire rope loop is pushed to the top again. This is repeated indefinitely. The rope between the holes is not cut and hangs below the roof between the holes. The appearance is not unlike loose stitches of thread, hence the miners' term of sewing the roof up. The rope between the holes has no function. It is just not worth the cost of cutting it.

A ⅛-in. pipe is also pushed clear to the top of the hole. Next a short piece of ¾-in. pipe about 25 cm. (9-10 in.) with a cement gun connection is placed in the hole. Then a solid plug of SILEX is pushed into the hole about 10 cm. (4-5 in.) around the outside of the ¾-in. pipe, the ⅛-in. air vent pipe and around the two strands of wire rope. This SILEX hardens in a few minutes and will stand the cement gun pressure of about 20 atm. or 300 lb./sq. in. It is sold by Ingenir Harold Henschien & Co., Oslo, Norway.

A hand pump is used to pump cement grout into the drill hole and all the cracks and fissures which the drill hole has cut. Air is ejected through the air vent pipe as the cement grout rises in the hole and is eventually filled with the grout. When cement can no longer be forced into the drill hole, the job is complete.

Success of this method is attributed to the fact that loose rock is cemented into one solid block which is suspended by the wire rope loops in the drill holes from solid rock overlying the loose rock. The system has been used for about seven years with no failures. Earlier attempts were unsuccessful because the air was not vented out of the hole. As soon as this was done, however, the system proved to be a complete success.

Mr. Einar Tröften is chief mining engineer for this company and has originated this method of "sewing the roof in place." He says that the depth of the holes and the distance between them are the result of experience and are not based on any mathematical formulas, but some mathematical investigations are being made.

The Conveyor Belt —Its Selection and Maintenance

FRED MATHEIS
Assistant Vice President
Thermoid Company
Trenton, N. J.

ALTHOUGH MANY DIFFERENT types of conveyor belts are available for a wide variety of services, they are all of similar construction in having essentially a carcass and a cover.

The carcass is made up of one or more plies of cotton fabric duck in which the lengthwise threads, or warp, are woven over and under the cross threads, or filler, giving a distinctive elastic quality in the direction of travel. The warp threads provide the belt's primary strength. Duck is specified by its weight per linear yard (42-in. width), such as 28 oz., 32 oz., 35 oz., and 45 oz. When belting is subjected to severe flexing a thin sheet of rubber between the plies, known as a "skim," is advantageous.

Covers are compounded of natural and synthetic rubber stocks and other ingredients which vary according to the service intended. A smooth rubber surface is normally furnished in various thicknesses to resist abrasion, heat, cutting, and gouging. For severe service, a breaker strip, consisting of a ply of open-mesh fabric, is inserted under the cover. This increases the cover adhesion, for maximum resistance to possible separation. Although each ply usually extends across the width of the belt, a special type of construction, known as step-ply, is available. In this type, the belt thickness is uniform, but a thicker layer of rubber in the center and additional duck plies at the sides are provided. This construction is to be considered when extreme wear is anticipated in the middle of the belt, as when abrasive materials are to be handled.

Usually, in industrial plants the top cover is thicker than the bottom cover because the former gets the most wear. There is a trend today, however, toward use of thicker covers on the bottom, in severe, abrasive service to cope with bottom-cover wear.

A smooth surface belt is accepted as standard in the mining industry. However, the jobs done by standard and special belts in all types of industry is amazing. New belts are constantly being designed for new tasks.

In cases where special conditions call for long belts, rayon duck or rayon cord can be used instead of cotton in the carcass for extra tensile strength. Steel wire or cable is used for extra strength in rare instances where the center-to-center distance of pulleys measures thousands of feet. Such belts, however, are very expensive.

Selecting Type and Size

To choose the correct type of belt consider first the size, density and sharpness of the pieces of material to be carried. Large pieces of heavy rock in sharp fragments will require a belt with a thick cover, breaker strip and several plies with skims. Light, fine material can be moved on a less rugged belt.

Allow for extremes of temperature in respect to material and in working environment. Belts for both hot and cold materials and climates can be produced.

Moisture content of the material is important. Wet mixtures require a different belt than dry ones.

Material in fine sizes, if abrasive, may require a heavy cover in spite of the small particles.

Size of belt to be selected is dependent upon the rate at which the material is to be moved, the distance, and the horsepower required. In general, the wider the belt the greater the cost. For a given tonnage per hour, the faster the belt travels, the narrower the belt required. However, the faster the belt runs, the more often it will pass the loading point and the greater will be the wear and maintenance. So it does not pay in the long run to save on the first cost of conveyor belting by running a narrow belt at high speed. Conversely, the capital cost of belting will be excessively high if a very wide belt is run at relatively slow speeds. A break-even point which takes into account a great many factors should be calculated.

For example, a high-speed belt requires more expensive rollers. A wide, slow-speed belt will take longer rollers which may be just as expensive. The high-speed rollers will require more attention. There are many tables, formulas and standard practice guides to assist the design engineer in making his choice.

A well-proportioned belt has enough plies to support the load and withstand tension. It must be flexible enough to trough and bend over pulleys without stressing the belt excessively. In general, the minimum ply belt to support the live load also satisfies tension requirements. On flat travel over short distances, the belt operates below tension capacity. Manufacturers' manuals contain tables and formulas for use in choosing a well-proportioned belt.

The edges of a belt are carefully sealed in manufacture to prevent moisture from getting in. Excessive edge wear destroys this seal. Water will then attack the carcass, causing mildew and rot. If the water freezes, the ice particles will rapidly destroy the belt.

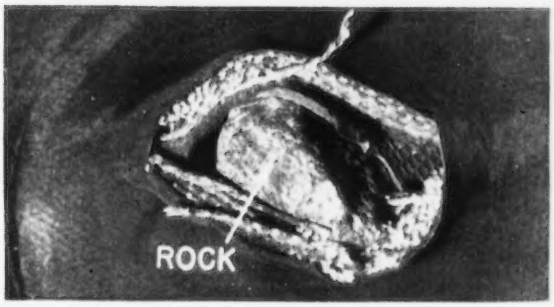
Many specialists consider edge wear one of the chief causes of short belt life. Misalignment is a large factor in edge wear. It is essential for long belt life that the belt carriers be correctly aligned. In general, it will pay off in terms of increased belt life to take time and trouble to get alignment as near perfect as possible. Many installations are aligned with a transit. Reducing edge wear usually means a reduction in power consumption.

Compensation Is Made for Excessive Edge Wear

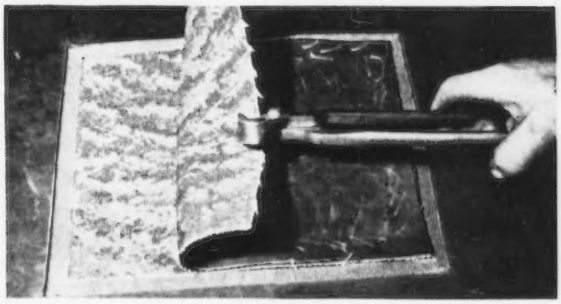
It is becoming standard practice to compensate for excessive edge wear by cutting off the worn edges before the belt has completely disintegrated and using the reclaimed, narrower belt in less severe service. New liquid Neoprene compounds are available for sealing the newly formed edges against moisture. Liquid Neoprene is also useful in building up worn spots in the cover to prevent more extensive repairs later.

Skirt boards are another primary cause of edge-wear. Construction and placement must be carefully

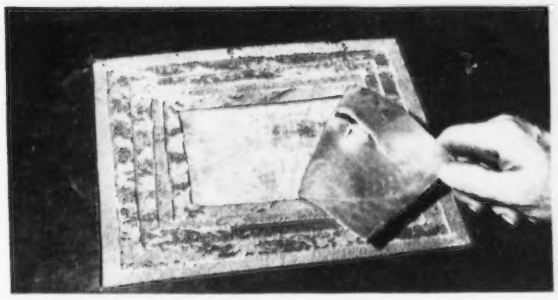
To Repair Conveyor Belt a Vulcanized Patch Is Made



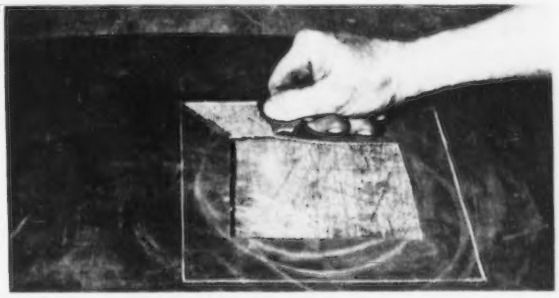
1. SERIOUS puncture calls for patch. Cut out top cover, then successively smaller rectangles of underlying fabric plies and, finally, bottom cover, as per following pictures.



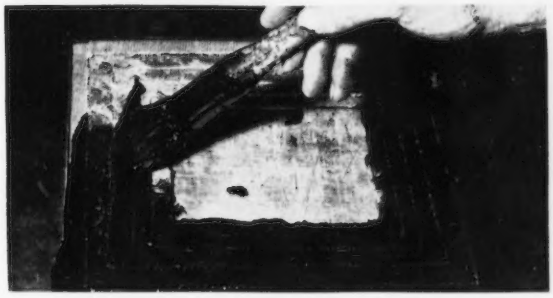
2. AFTER laying out rectangle with square on top cover parallel with belt edge, half-inch strip of cover is removed around edge, then piece is cut out of first ply of fabric.



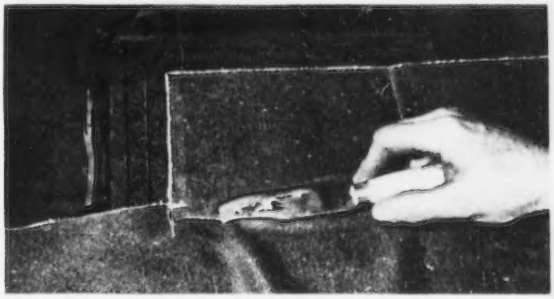
3. SUCCESSIVE fabric layers are then removed, each decreasing in dimensions, and finally bottom cover is cut out, completely removing damaged portion.



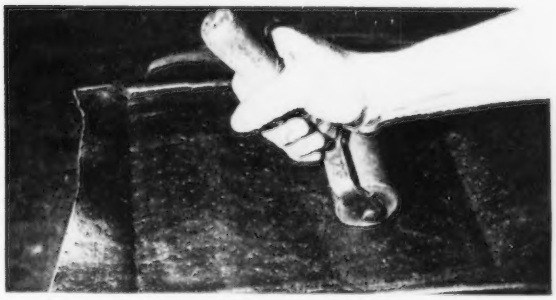
4. BELT is now turned over and bottom fabric layer is exposed as shown by removing strip 2 in. wide of bottom cover. Belt is now ready for cementing patch on.



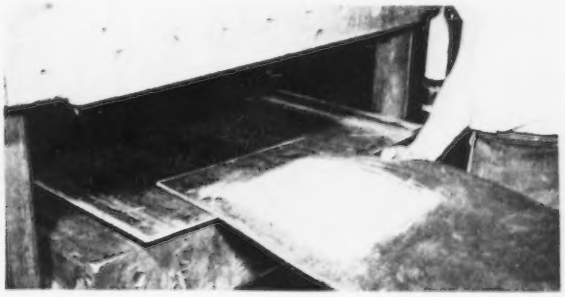
5. RUBBER cement is applied to exposed fabric on which patch is to be laid, after making sure that fabric is dry, and cavity has been cleaned and roughened.



6. AFTER cement has been applied, squares of rubber-impregnated fabric are cut to fit each layer until cavity has been filled.



7. PIECE of uncured rubber, of same thickness and composition as original cover, is cemented in and rolled flush. Overlapping edges are trimmed flush with cover.



8. BELT, now patched, is placed in vulcanizer for final step of the repair operation. Any unremoved moisture will form internal steam blisters.

engineered and use of jerry-built, "baling wire" contrivances avoided. The boards should be fastened firmly so that they will not loosen and drag on the belt.

Loading Impact A Factor in Wear

Loading conditions are a prime factor in belt deterioration. The loading point is a danger zone. Existing and proposed installations should be studied with the idea of creating "ideal" conditions for loading.

One of the basic requirements is that the material must fall on the belt while moving in the same direction and at the same speed as the belt.

The material should be directed to the center of the belt, not toward one side. Material falling on the left side will make the belt ride out toward the right and vice versa. As a result, the belt will not train properly and will run against guard boards and training idlers, if these are used, increasing edge wear.

When lumpy material is being carried, an attempt should be made to have it cushioned by a pre-laid layer of fine material. A screen or grizzly at the bottom of the chute will deposit a layer of fines over the belt, protecting it against bruising. In some cases, an oval or "fish tail" notch cut in the chute lip will aid in pre-laying the fines.

At the same time, the velocity of flow of the loading material should be controlled by pitching the loading chute properly. If this is not feasible, a baffle of iron or wooden bars should be built in the chute, suspended from the top and swinging free at the bottom, to reduce the velocity of flow onto the belt.

The vertical distance between chute and belt should be small to prevent excessive velocity of material in falling. With lump material, this might be great enough to cause belt damage.

Material should strike the belt between idlers and not directly above a solid pulley. The hammer-anvil action resulting in the latter case will quickly render the belting unusable. However, where heavy material is being loaded, it may be necessary to load directly over rubber-covered or pneumatic idlers.

In cases, the impact load between idlers will set up belt vibration. Resultant chattering may depress the belt sufficiently to let material escape under the skirt boards. To prevent this the chute can be located so that the material will strike the belt far enough ahead of the tail pulley to allow insertion of at least one belt-steadying carrier pulley. Also the carrier pulleys should be spaced more closely around the loading zone because of the impact loading of belt at that point.

Pointers on Skirts

Construction of loading-chute skirt boards and flexible skirts should be carefully considered. Skirt boards should not touch the belt but should be positioned slightly above it. They should be long enough to settle the material before it leaves the loading area. Where flexible skirts are used, they can preferably be improvised from rubber-covered edges of belting remnant. These remnants should be placed so that the rubber-covered edge is next to but not touching the belting. If this is reversed and the exposed fabric edge of remnant placed against the moving belt, grit will collect in the fabric. Resultant abrasive action will, in time, wear a track through the belt cover.

Vertical spacing between chute skirt-boards and belt should increase toward the open end of the chute. Thus the width of flexible skirts, as cut from a belt remnant, should decrease in the direction of belt travel. This will minimize spillage around the loading point. Also, wedged-in lumps of material will work themselves free by the forward motion of belting.

Belt Maintenance Begins on Receipt

Belt maintenance begins even before the belt is installed. When received by truck or rail, the belt should never be dropped off but should be skidded, rolled or lifted. A large roll of belt will weigh several tons. A short computation will show that several tons falling from a freight car will develop a surprising impact over the area of contact, enough to weaken the belt. If the belt roll falls on a stone, tool or track, a cut or puncture may result. If the belt is not installed at once, it should be stored and protected from sunlight, in a place where it is not likely to be damaged accidentally.

The work of threading the belt over the idlers and pulleys when installing it is critical. Much damage may be done to the belt at this time. More than ordinary care and planning are needed. Sharp bends and twists must be avoided, dragging over sharp rough surfaces minimized. Before the belt is run, a check should be made for tools left accidentally on the return side. Excessive tension should not be used in pulling the belt over the idlers and pulleys.

Authority and responsibility for belt maintenance should be delegated to one man. With his assistants, the maintenance boss checks lubrication, condition of idlers and pulleys, examines the belt for excessive wear, inspects splices at frequent intervals, repairs cuts and tears as soon as discovered, maintains a kit of belt repair tools. He also should check the belt for oil and grease which should be removed. Over-lubrication of pulleys and idlers should be avoided. Operators having much belting may be justified in maintaining a belt repair shop with vulcanizing equipment, belt tables, drying racks.

Belt Repairs

To get the maximum service life out of conveyor belting, all belt damage should be repaired as soon as it is discovered. Belt fabric exposed to weather will absorb moisture if the protective cover is damaged, and may even become soaked. In warm weather, this condition leads to mildew and rot; in winter, ice crystals may gnaw at the fabric from within as the belt flexes. Immediate repairs prevent the spread of damage and keep the water out.

An adequate repair kit includes sharp cobbler's knives and a stone to keep them sharp; a supply of emery cloth, rubber cement, inner-tube patching rubber, rip plates and standard belt-fasteners and accessories, together with rags and gasoline for cleaning. As each belt is installed, remnants should be saved, because they will prove useful in subsequent repairs.

To mend long and deep cuts which go through to the fabric, open the cut, clean out all dirt, and cement the cut closed, allowing the cement to dry thoroughly before the belt is restored to service. Where bits of torn cover leave exposed spots with only slight damage to the fabric, remove the loose ears of cover stock by carefully cutting a curved and bevel-edged area around the spot, sand the edges, and apply the patch flush with the belt cover.

Where gouges have penetrated the belt, or longitudinal rips have occurred, these points must be cleaned, sanded, cemented and reinforced with rip plates at 3-in. intervals.

(*Continued on p. 198*)

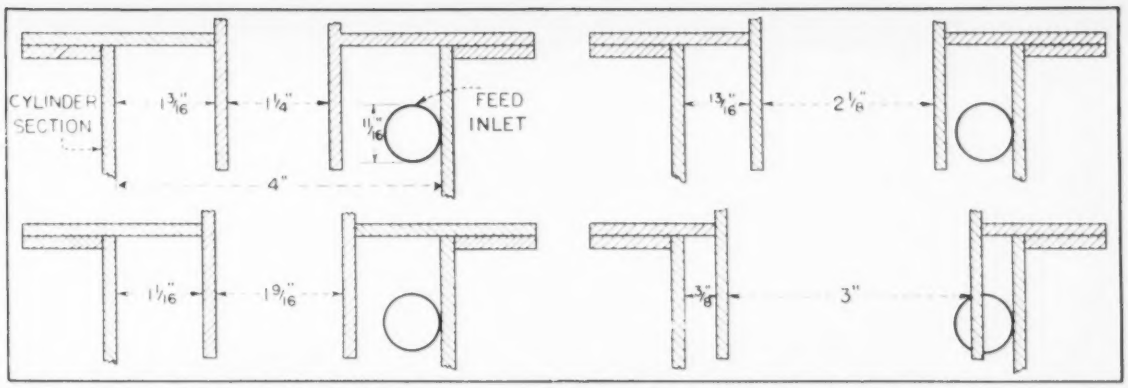


FIG. 5. EFFECT OF VORTEX DIAMETER upon core thickness of pulp in cyclone is illustrated by scale sections through vortex finder, here shown.

Factors Affecting Ore Separations in a 4-in. DSM Cyclone Separator (Part 2)

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Mr. Herkenhoff's object in preparing this paper, as explained in Part 1 (August issue, pp. 88-91), is to present information on medium and ore flows when minus 1¼-in. low-grade iron ores are treated in cyclone separators. The work done was limited to batch tests using a 4-in. diameter cyclone. Part 1 described the cyclone chosen, discussed feed capacities, and started the presentation of findings derived from the tests. This is continued in Part 2 (the concluding part), after first telling how the procedure of making an ore separation test was standardized.

The Standardized Procedure

THE PROCEDURE EMPLOYED in making an ore separation test was standardized as follows:

The ore sample was all minus-¼-in. and was washed on 80-mesh. The minus ¼-in. plus 80-mesh fraction was allowed to drain about 15 minutes for removal of free water. With Mesabi ores, this usually resulted in a moisture content of 15 to 18%. Approximately 30 to 35 lb. of the moist ore was used for a batch test, depending upon the desired ratio of ore to medium.

A weighed amount of water was dumped into the sump and magnetite was added—120 to 140 lb. usually—until the medium feed slurry reached the desired density. The by-pass valve was open to obtain maximum circulation through the sump.

The drained ore sample then was added and, after allowing about one minute for thorough mixing, the by-pass valve was closed. Simultaneous cuts of the cyclone products were taken, the pulps were weighed and then screened and washed on 80-mesh. In this connection, a mechanically-operated screen is advantageous for washing the products. A screen 12 in. in diameter connected to a laboratory shaking-table head motion has proved very satisfactory in our work. If desired, the magnetite may be reclaimed later from the minus-80-mesh washings, but in our work was discarded.

Structure of Ore Samples. The structure of the lean iron ores used in the tests reported in Table 6 and in the first section of Table 11 is as follows. These figures may be considered as typical:

	Ore Used in Table 6 % Weight		Ore Used in Table 11 % Weight*	
Mesh	In Size	Cum.	In Size	Cum.
+ 4	6.21		2.12	
+ 6	22.72	28.93	17.02	19.14
+ 8	16.58	45.51	17.91	37.05
+10	12.42	57.93	16.43	53.48
+14	9.66	67.59	13.94	67.42
+20	8.16	75.75	10.32	77.74
+28	6.50	82.25	8.45	86.19
+35	5.69	87.94	5.13	91.32
+48	5.01	92.95	3.03	94.35
+65	4.39	97.34	1.75	96.10
+80	2.08	99.42	0.68	96.78
−80	0.58	100.00	3.22	100.00

*Actual classifier rake product from operating iron-ore wash plants.

Effect of Varying Diameter of Vortex Finder

The data in Table 2 (Part 1) show that the overflow medium gravity is affected by the vortex opening. Similarly, the ore separation in a cyclone separator may be controlled by varying the diameter of the vortex finder or overflow outlet. Table 6 illustrates this effect in the separation of a minus ¼ in. plus 80 mesh lean iron ore using an all-magnetite medium.

Inspection of Table 6 will show that, as the vortex diameter was increased, the underflow product decreased in weight but increased in grade. It is surprising that even with a 3-in. diameter vortex a concentrate was made although the recovery was understandably low.

For their interest, the results of a test using a truncated 25 deg. cone are included in Table 6. Note

Part 1 of this article appeared in the August issue, pages 88-91. Part 1 included Tables 1-5, inclusive, and Figs. 1-4, inclusive. Presented at University of Minnesota Mining Symposium, Duluth, Minn., January 1953.

TABLE 6. Effect of Varying Vortex Finder Diameters on Ore Separations

Test No.	Product	Flow Splits: % Weight Ore Plus Medium	Flow Splits: % Weight Dry Ore	Flow Splits: % Weight Medium	Ore Separation: Assay % Iron	Ore Separation: Assay % Silica	Ore Separation: % Distribution of Iron	Medium Sp. Gr.	Ratio Dry Ore to Medium	Cyclone: Vortex Dia., In.	Cyclone: Conical Section
11-M	Feed	100.00	100.00	100.00	48.22	18.06	100.00	2.33	1 to 7.6	1¼	25°
	Overflow	71.01	28.88	76.55	35.17	36.36	21.06	2.29	1 to 20.0		Tapered
	Underflow	28.99	71.12	23.45	53.52	10.63	78.94	2.67	1 to 2.51		
14-M	Feed	100.00	100.00	100.00	48.25	18.59	100.00	2.32	1 to 8.1	1⅜	25°
	Overflow	79.13	37.25	84.30	38.00	32.73	29.34		1 to 18.3		Tapered
	Underflow	20.87	62.75	15.70	54.33	10.19	70.66		1 to 2.03		
13-M	Feed	100.00	100.00	100.00	48.75	17.71	100.00	2.32	1 to 7.3	2⅛	25°
	Overflow	79.26	43.41	84.15	41.07	28.16	35.67	2.27	1 to 14.2		Tapered
	Underflow	20.74	56.59	15.85	54.65	9.70	63.43	2.72	1 to 2.05		
12-M	Feed	100.00	100.00	100.00	47.73	19.26	100.00	2.33	1 to 7.2	3	25°
	Overflow	85.78	54.89	89.40	41.72	27.70	47.97		1 to 13.9		Tapered
	Underflow	14.22	45.11	10.60	55.06	9.00	52.03		1 to 2.0		
10-M-B	Feed	100.00	100.00	100.00	48.91	17.03	100.00	2.33	1 to 6.7	1¼	25°
	Overflow	76.27	41.50	81.41	41.39	27.12	35.12		1 to 13.3		Truncated
	Underflow	23.73	58.50	18.59	54.25	9.87	64.88		1 to 2.14		

In all tests the apex diameter was $^{11}/_{16}$ in. Heavy-liquid separation of cyclone ore feed at 2.95 specific gravity gave a weight recovery of 68.79% assaying 51.58% iron and 11.67% silica.

TABLE 7. Effect of Auxiliary Cylindrical Section on Ore Separations

Test No.	Product	Flow Splits: % Weight Ore Plus Medium	Flow Splits: % Weight Dry Ore	Flow Splits: % Weight Medium	Ore Separation: Assay % Iron	Ore Separation: Assay % Silica	Ore Separation: % Distribution of Iron	Medium Sp. Gr.	Ratio Dry Ore to Medium	Cyclone: Conical Section	Cyclone: Auxiliary Cylinder
19-SL1	Feed	100.00	100.00	100.00	33.64	42.39	100.00	2.51	1 to 4.7	25°	*None*
	Overflow	78.83	53.55	84.17	20.00		31.84	2.50	1 to 7.43	Tapered	
	Underflow	21.17	46.45	15.83	49.36	19.21	68.16	2.73	1 to 1.6		
19-SL3	Feed	100.00	100.00	100.00	33.27		100.00	2.51	1 to 5.4	25°	*Yes*
	Overflow	78.56	45.33	84.72	14.35		19.55		1 to 10.1	Tapered	
	Underflow	21.44	54.67	15.28	48.95	19.49	80.45		1 to 1.5		
19-S12	Feed	100.00	100.00	100.00	32.54		100.00	2.51	1 to 5.1	25°	*Yes*
	Overflow	87.82	75.30	90.25	26.94		62.35		1 to 6.1	Truncated	
	Underflow	12.18	24.70	9.75	49.60	19.18	37.65		1 to 2.0		

In all tests, vortex = 2⅛ in.; apex = $^{11}/_{16}$ in. Medium was all magnetite.

that, although the medium split in the cyclone was not greatly different from that in the first test using a tapered cone, the weight recovery of ore in the underflow was sharply reduced. The result in the third test (using a tapered cone and a 2⅛-in. vortex) was about equivalent to that obtained with a 1¼-in. vortex and a truncated cone.

Included in Table 6 are the calculated ratios of dry ore to medium in the cyclone feed, overflow and underflow products. It is interesting to note that the apex product may reach a high solids consistency (85-89% solids, as further discussed in Table 8), whereas the overflow product consists largely of medium and a small proportion of the ore feed.

The effect of the vortex diameter upon the core thickness of pulp in the cyclone may best be illustrated by scale sections through the cyclone feed inlet parallel to the longitudinal axis. The scale sections are shown in Fig. 5. Truncated conical sections and cones having round bottoms are useful in treating certain ores and have an operational advantage in being less susceptible to choking, but usually the efficiency of the separation is lowered. The results of tests shown in Table 6 suggest that the separations obtained with truncated cones can also be obtained by use of vortex finders of larger diameter.

Effect of Auxiliary Cylindrical Section on Ore Separations

The effect of an auxiliary cylindrical section on iron ore separation may be illustrated in the tests shown in Table 7.

A 2⅛-in. high cylindrical section was inserted between the feed inlet and conical sections, as illustrated in Fig. 3 (Part 1). The ore treated was a very lean siliceous hematite of near-taconite characteristics; at a 2.95 specific gravity, the heavy liquid sink products assayed 48.98% iron and 18.53% silica; at 3.30 specific gravity, the silica content still was over 14%.

Effect of Various Ratios of Ore to Medium in Cyclone Feed

In ore separation circuits, the ratio of ore to medium is important because of the effect upon the ore tonnage capacity of the cyclone. The capacity of the cyclone circuit for medium only is relatively constant, whereas the ore capacity may vary depending upon the amount of ore that is suspended in the feed medium. Therefore, the cyclone plant design data, it is highly important to determine the optimum ratio of ore to medium.

Some tests illustrating the effects of varying ratios of ore to medium are shown in Table 8. The ore used in these tests was the same as that used in the tests with varying vortex diameters as

TABLE 8. Effect of Various Ratios of Ore to Medium in Cyclone Feed

Test No.	Product	Flow Splits: % Weight Ore Plus Medium	Flow Splits: % Weight Dry Ore	Flow Splits: % Weight Medium	Ore Separation: Assay %: Iron	Ore Separation: Assay %: Silica	Ore Separation: % Distribution of Iron	Medium Sp. Gr.	Ratio Dry Ore to Medium	Calculated % Solids in Pulp
33-M	Feed	100.00	100.00	100.00	48.74	17.85	100.00	2.32	1 to 9.85	76.3
	Overflow	68.09	24.29	73.03	33.92		16.90	2.24	1 to 26.80	72.2
	Underflow	31.91	75.71	26.97	53.50	10.62	83.10	2.76	1 to 3.10	86.3
31-M	Feed	100.00	100.00	100.00	49.73		100.00	2.32	1 to 5.95	
	Overflow	64.14	19.70	71.61	34.13		13.52		1 to 21.70	
	Underflow	35.86	80.30	28.39	53.56	10.05	86.48		1 to 2.10	
32-M	Feed	100.00	100.00	100.00	50.54		100.00	2.32	1 to 4.90	78.5
	Overflow	55.19	17.09	64.97	35.93		12.15		1 to 14.80	72.7
	Underflow	44.81	82.91	35.03	53.56	10.40	87.85		1 to 1.64	88.9
37-M	Feed	100.00	100.00	100.00	50.26		100.00	2.32	1 to 3.16	80.4
	Overflow	49.41	17.95	59.35	37.59		13.42		1 to 10.40	73.5
	Underflow	50.59	82.05	40.65	53.04	11.16	86.58		1 to 1.57	89.2

In all tests, the vortex was 1 3/16 in. and the apex was 15/16 in. The cone was a 25° tapered cone and no auxiliary cylindrical section was used.

TABLE 9. Effect of Magnetized Medium

Test No.	Product	Flow Splits: % Weight Ore Plus Medium	Flow Splits: % Weight Dry Ore	Flow Splits: % Weight Medium	Ore Separation: Assay %: Iron	Ore Separation: Assay %: Silica	Ore Separation: % Distribution of Iron	Medium: Sp. Gr.	Medium: Magnetized	Cyclone: Apex, In.	Cyclone: Vortex, In.	Ratio Dry Ore to Medium
30M	Feed	100.00	100.00	100.00	48.54		100.00	2.32	No	11/16	1 3/16	1 to 10.6
	Overflow	79.93	37.09	84.37	38.46		29.39					
	Underflow	20.07	62.91	15.63	54.46	9.04	70.61					
35M	Feed	100.00	100.00	100.00	48.14		100.00	2.32	Yes	11/16	1 3/16	1 to 11.8
	Overflow	80.28	32.92	84.66	35.39		24.20					
	Underflow	19.72	67.08	15.34	54.39	10.03	75.80					
33M	Feed	100.00	100.00	100.00	48.74		100.00	2.32	No	15/16	1 3/16	1 to 9.9
	Overflow	68.09	24.29	73.03	33.92		16.90					
	Underflow	31.91	75.71	26.97	53.50	10.62	83.10					
34M	Feed	100.00	100.00	100.00	48.15		100.00	2.32	Yes	15/16	1 3/16	1 to 10.9
	Overflow	70.14	23.33	74.86	31.64		15.33					
	Underflow	29.86	76.67	25.14	53.17	10.87	84.67					
37M	Feed	100.00	100.00	100.00	50.26		100.00	2.32	No	15/16	1 3/16	1 to 3.2
	Overflow	49.41	17.95	59.35	37.59		13.42					
	Underflow	50.59	82.05	40.65	53.04	11.16	86.58					
38M	Feed	100.00	100.00	100.00	50.20		100.00	2.32	Yes	15/16	1 3/16	1 to 3.7
	Overflow	55.22	14.87	65.97	34.93		10.35					
	Underflow	44.78	85.13	34.03	52.87	11.42	89.65					

shown in Table 6, opposite page.

It may be noted that the calculated head assays of the batches of ore used in each test vary somewhat, and the weight recovery, therefore, varies also. Of most importance, however, is to note that the grade of underflow product was nearly uniform.

Referring to Table 8, it is to be noted that the apex diameter was 15/16 in. A smaller apex may be used when employing higher ratios of ore to medium but, in the case of the ore used in these tests, choking resulted at ratios lower than 1 to 9. Choking occurs when the capacity of the apex for the sink product is exceeded and is a function of the crude-ore feed rate and structure, weight recovery, ratio of ore to medium in the feed, and the type of cyclone conical section. With low-weight recovery ores, the ore feed capacity of a given cyclone is greater than for high-weight recovery ores, other things being equal. This is due to the fact that the capacity of the apex opening is the critical factor; the vortex or overflow opening has ample capacity to handle the entire feed without choking. It is important, therefore, not to overfeed the cyclone separator with ore or use too small a cyclone for a given ore-feed rate.

In practice, where drainage screens are employed following the cyclone separator, the provision of excess cyclone-separator capacity usually calls only for increased power for circulating medium through the cyclone. The advantages to be gained would appear to offset the higher pumping cost.

In one case, with a minus-4-mesh ore-feed rate of 34 lb. per minute, the apex discharge from the 4-in. cyclone was 213 lb. of pulp (ore plus medium) per sq. in. area of the apex opening and no choking occurred. With the same conditions, but an ore feed rate of 58 lb. per minute, choking occurred at the equivalent of 300 lb. of pulp per sq. in. area of the apex opening. When the apex opening was increased and the pulp flow dropped to 161 lb. per sq. in. per minute, operation was satisfactory.

The very high solids content of the cyclone apex product may be noted by referring to the ratios of dry ore to medium in the cyclone products. The ratio of 1.50 to 1 in the apex product approximates the lowest obtained in the test work.

Effect of Magnetized Medium

As mentioned earlier, the medium used in our routine tests has not been demagnetized but, due to aging, is not strongly magnetized. Some tests were run to determine the effect of magnetizing the medium by placing magnetizing blocks

on the pipe that feeds the cyclone.

The data from the tests are recorded in Table 9, where it can be seen that there is a slight but definite effect of magnetizing the medium. These data indicate that the reject material is somewhat leaner when magnetized medium is used; the underflow ore product has a slightly lower grade, but the weight recovery is better.

Comparison of Medium Splits With and Without Ore in Cyclone Feed

Table 2 (Part 1) contains data on flow splits of medium when no ore is present in the feed. When ore is present in the medium being pumped to the cyclone, the splits of medium are changed and more medium is carried into the underflow than when no ore feed is present. This can best be seen by referring to Table 10 wherein it can be seen that the quantity of medium discharged from the apex is nearly double than when no ore is present. It is probable that the comparative weight splits of medium will be a function of grade of the ore (quantity reporting in the underflow) as well as the structure of the ore (surface area of the underflow ore product).

Effect of Medium Gravities on Ore Separations

The ore separation in a cyclone plant generally is controlled by varying the medium gravity, as in static high-density separations. The overflow medium gravity is the control point usually, and a "top gravity" of 2.1 to 2.35 gives a good separation of most lean iron ores. However, where refractory, high middling ores are treated, higher medium gravities may be desired and may yield concentrates of improved grade. With the type of magnetite medium employed in our tests, the maximum workable gravity was about 2.45 to 2.50, and it would be difficult to maintain such gravity in an operating plant due to dilution by moisture in the ore feed.

The results shown in Table 11 illustrate the effect of medium gravities on the separation of two lean iron ores—one that was easy to treat, and one (also used in tests reported in Table 7) that was refractory.

Data on medium flows and ore-to-medium ratios are shown with the metallurgical results in Sec. 1 of Table 11. In Sec. 2, two types of medium were employed—in the first, a mixture of fine ferrosilicon and magnetite; in the second, magnetite only.

It should be pointed out that the changing ratio of ore to medium in the feeds of Tests 1-4 of Sec. 1 was due to some settling out of ore in the pump sump. In some cases, a slight difference in grade of the ore feed between various tests may result from this settling.

With reference to the ore and medium splits, it is evident that the weight split of ore plus medium is relatively unchanged by decreasing the gravity of the medium.

It is to be noted from the results shown in Sec. 2 that the ore weight recovery was greatly decreased at high feed gravities, but with only slight improvement in grade of product. This was due to the inherent high silica content of the ore particles.

Effect of Fineness of Medium on Ore Separations

Some information on the effect of the fineness of the medium on ore separations was obtained by treating three portions of an ore

TABLE 10. Comparison of Medium Splits With and Without Ore in Cyclone Feed

With Medium Only % Weight			With Ore Plus Medium % Weight			Cyclone		Ratio Dry Ore to Medium
No.	Overflow	Underflow	No.	Overflow	Underflow	Apex, In.	Vortex, In.	in Feed
10M	88.91	11.09	11M	76.55	23.45	11/16	1 1/4	1 to 7.6
13MA	91.68	8.32	14M	84.30	15.70	11/16	1 9/16	1 to 8.1
13MB	90.72	9.28	19SL-1	84.17	15.83	11/16	2 1/4	1 to 4.7

TABLE 11. Effect of Medium Gravities on Lean Iron Ore Separations

Section 1. Easy Ore

		Flow Splits			Ore Separation						
					Assay %						
Test No.	Product	% Weight Ore Plus Medium	% Weight Dry Ore	% Weight Medium	Iron	Silica	Man.	% Distribution of Iron	Feed Medium Sp. Gr.	Ratio Dry Ore to Medium
1	Feed	100.00	100.00	100.00	49.62	17.84	2.07	100.00	2.35	1 to 60
	Overflow	74.67	37.82	80.79	41.85		0.68	31.90		1 to 12.8
	Underflow	25.33	62.18	19.21	54.35	8.68	2.91	68.10		1 to 1.86
2	Feed	100.00	100.00	100.00	48.95		2.07	100.00	2.26	1 to 6.9
	Overflow	74.65	29.70	81.20	37.14		0.55	22.53		1 to 18.8
	Underflow	25.35	70.30	18.80	53.95	9.60	2.71	77.47		1 to 1.84
3	Feed	100.00	100.00	100.00	49.24		1.88	100.00	2.19	1 to 8.5
	Overflow	76.61	25.95	82.57	36.98		0.42	19.49		1 to 27.0
	Underflow	23.39	74.05	17.43	53.54	10.30	2.39	80.51		1 to 2.0
4	Feed	100.00	100.00	100.00	48.63		2.21	100.00	2.15	1 to 9.06
	Overflow	76.87	22.60	82.86	34.06		0.48	15.83		1 to 33.3
	Underflow	23.13	77.40	17.14	52.89	11.06	2.72	84.17		1 to 2.0

In all tests, vortex finder was 1 9/16 in. diameter; apex was 11/16 in. Conical section was tapered.

Section 2. Refractory Ore

	Medium Gravity		Underflow Product			Recovery of Iron	Cyclone Conical
Test No.	Feed	Overflow	% Weight	% Iron	% Silica	%	Section
19SL-5	2.67	2.63	32.77	49.94	18.53	48.89	Tapered 25°
-6	2.58		39.02	49.94	18.62	57.45	Tapered 25°
-7	2.47		51.30	48.71	20.35	70.63	Tapered 25°
-8	2.38		54.21	48.15	21.35	75.71	Tapered 25°
(Above tests employed a 25 to 75 mixture of ferrosilicon and magnetite)							
19SL-1	2.51	2.50	46.45	49.36	19.21	68.16	Tapered 25°
-2	2.51	2.50	24.70	49.60	19.18	37.65	Truncated 25°
-3	2.51		54.67	48.95	19.49	80.45	*Tapered 25°
-4	2.48		61.57	47.74	21.73	86.90	*Tapered 25°
(Above tests employed all-magnetite medium)							

In all tests, cyclone vortex opening was 2 1/4 in. dia.; apex opening was 11/16 in. Feed pressures ranged from 15 to 22 lb. Ratios of ore to medium were about 1 to 5. *Cyclone had an auxiliary cylindrical section.

TABLE 12. Effect of Fineness of Medium on Ore Separations

Test No.	Product	Flow Splits: % Weight Pulp	% Weight Ore	% Weight Medium	Ore Separation: Assay % Iron	Assay % Silica	% Distribution of Iron	Feed Gravity: Ore Plus Medium	Type of Medium
E-1	Feed	100.00	100.00	100.00	49.40		100.00	2.32	Fine
	Overflow	64.71	14.03	71.37	34.06		9.67		
	Underflow	35.29	85.97	28.63	51.90	12.38	90.33		
E-2	Feed	100.00	100.00	100.00	49.66		100.00	2.23	Fine
	Overflow	67.64	9.25	74.43	30.82		5.74		
	Underflow	32.36	90.75	25.57	51.58	13.35	94.26		
E-3	Feed	100.00	100.00	100.00	48.88		100.00	2.32	Regular
	Overflow	60.32	17.29	67.37	32.11		11.36		
	Underflow	39.68	82.71	32.63	52.39	12.07	88.64		
E-4	Feed	100.00	100.00	100.00	49.53		100.00	2.23	Regular
	Overflow	59.50	12.64	66.50	29.20		7.45		
	Underflow	40.50	87.36	33.50	52.47	12.77	92.55		
E-5	Feed	100.00	100.00	100.00	50.51		100.00	2.32	Coarse
	Overflow	55.17	20.81	61.06	36.01		14.84		
	Underflow	44.83	79.19	38.94	54.32	9.56	85.16		
E-6	Feed	100.00	100.00	100.00	50.81		100.00	2.23	Coarse
	Overflow	54.23	14.94	60.49	33.57		9.87		
	Underflow	45.77	85.06	39.51	53.84	9.74	90.13		

Cyclone—Vortex, 1¼ in.; apex, $^{15}/_{16}$-in.; feed pressure, 15-19 psi.; and tapered cone 25°.

sample (the same as used in tests reported in Tables 6 and 8) in media ranging from relatively coarse to very fine. In these tests, the cyclone apertures and the specific gravity of the medium fed to the cyclone were kept constant; the only variable was the structure or particle size of the medium.

Screen analyses of the magnetite media were as follows:

Mesh	Percent Weight: Fine Medium	Regular Medium	Coarse Medium
+35		0.13	0.14
+48	0.15	0.19	0.40
+65	0.21	0.71	1.18
+100	0.64	2.13	3.39
+150	1.92	5.38	8.70
+200	2.91	5.99	8.94
+325	8.92	16.70	18.85
−325	85.25	68.77	58.40
Total	100.00	100.00	100.00
% solids at 2.27 sp. gr.	71.4	71.8	70.7

Two tests were run with each medium: one at a medium feed gravity of 2.27, and one at a gravity of 2.17. The ratio of dry ore to feed medium averaged 1 to 6.

Specific gravities of the underflow medium (with no ore in the feed) were measured at the start of the first test with each medium. These readings showed that the differential between overflow and underflow gravities was much less with the fine medium than with the coarse medium, as illustrated:

	Fine Medium	Regular Medium	Coarse Medium
Specific gravity, feed medium	2.27	2.27	2.27
Specific gravity, overflow medium	2.21	2.17	2.10
Specific gravity, underflow medium	2.50	2.63	2.73
Differential	0.29	0.46	0.63
Feed pressure, psi	22	22	20

The flow splits and metallurgical results of the tests are listed in Table 12. Inspection of this table shows that the ore separations varied considerably and were best when using the coarsest medium. Inasmuch as the feed gravity was the same in each case, the explanation for the variation in results centers about the specific gravities of the overflow and underflow medium. The overflow gravity was highest with the fine medium; the underflow gravity was highest with the coarse medium. These data show, therefore, that the gravity of the underflow medium has an important influence on the ore separation gravity and must be controlled as well as the feed gravity. In effect, a higher separation gravity was obtained with the same feed density when using coarse medium.

Inspection of the underflow products from Tests E-1 and E-6, at which the weight recoveries were 85.97 and 85.06, respectively, showed that the higher silica content in Test E-1 was due to free silica or quartz; such free silica was not observed in the underflow from Test E-6.

Effect of Cyclone Feed Pressures

The effect of varying the feed pressures was not investigated here, but, as will be noted from some of the foregoing tables, feed pressures varied from 15 to 22 lb., depending upon the volume of medium in the sump and specific gravity of the feed mixture. Pressures lower than 10 to 12 psi are not recommended.

Other work done with a 6-in. dia. cyclone showed that there was only a slight change in results when the feed pressure was varied from 20 to 35 psi.

In general, the higher feed pressure increases the cyclone capacity, increases the differential between the overflow and underflow medium gravities, and may increase the efficiency of separation in the finer sizes of ore. Wear will greatly increase the efficiency of separation in the finer sizes of ore. Wear will greatly increase as the feed pressure is increased.

Summary

A laboratory batch-testing 4-in. diameter cyclone separator has been described in this article. Essential dimensions of the cyclone and of the sump and pump which feed the cyclone are given in Part 1.

Data on the capacity of the cyclone for water only and for medium composed of fine magnetite and water are shown. The effects of various sizes of vortex finders and apex openings, and of truncated conical sections on medium densities and flow splits were studied. The classification effect of the cyclone on the medium, and the application of back pressure on the overflow discharge are discussed. A description of the procedure employed for tests on 20 to 30-lb. batches of minus ¼-in. ores is given.

The effects of the following variables on the separation of lean iron ores were studied:

1. Addition of an auxiliary cylindrical section between the feed inlet and conical sections.
2. Use of mixed media of ferrosilicon and magnetite.
3. Use of various sizes of vortex finders.
4. Various ratios of dry ore to medium in the cyclone feed.
5. Magnetized and not-magnetized medium.
6. Medium splits, with and without ore present in the feed.

(Continued on p. 206)

The Hidden Payroll

What do you actually pay men like the stope miners shown above? Messrs. Simons and Brown tabulate the real wage cost for the Coeur d'Alene district and suggest the facts be kept in mind elsewhere.

W. T. SIMONS,
President,
MALCOLM C. BROWN,
General Manager,
Sidney Mining Co., Kellogg, Idaho

WHEN YOU ARE ASKED, "How much do you pay per shift for a stope miner these days?" what do you say? Probably you say $13.54. If you do, you are simply giving a classification rate which is probably only 76% of the actual daily cost to you of that miner. That a similar percentage of hidden wages applies to every man on our payrolls in the mines and smelters of Idaho, we propose to show by data collected in the Coeur d'Alene mining district.

Of course we all know about these hidden costs, which we call "fringe benefits", but few of us know how much they actually cost in dollars and cents. They are non-wage items like holiday pay, vacation pay, various forms of insurance and many similar costs. In the spirit of "pamper 'em and keep 'em" management has, in the last half-dozen years, gone along piling one fringe on top of another as though these extras were as free as air, and labor has demanded them in the same spirit. It is doubtful if either management or labor realizes how much they cost now.

The United States Chamber of Commerce has classified non-wage items as follows:

I. Legally Required Payments

a. Old-age and survivors insurance (social security)

b. Unemployment compensation (Federal & state)

c. Workmen's compensation

d. State sickness benefits insurance.

II. Voluntary (or agreed-upon) Payments

a. Pension plan payments or premiums

b. Life insurance premiums

c. Death benefits not covered by insurance.

d. Sickness, accident, surgical or medical care insurance

e. Sick-leave pay, accident, surgical or medical care payments not insured

f. Hospitalization payments or insurance premiums (including cooperatives such as Blue Cross)

g. Separation or termination pay allowances

h. Discounts on goods and services purchased from company by employees.

III. Paid Rest Periods and Lunch Periods, including wash-up time, clothes-change time, travel time, get-ready time, etc.

IV. Payments For Time Not Worked

a. Payments for or in lieu of vacations

b. Payments for holidays not worked

c. Payments required under guaranteed work week

d. Jury, witness, and voting pay allowances

e. National defense, state or National Guard duty

f. Payment for time lost due to death in family or other personal reasons.

V. Other Items

a. Payments to union stewards or officials for time spent in settling grievances or negotiating agreements

b. Profit-sharing payments

c. Christmas or other special bonuses, service awards, suggestion awards, etc.

d. Special wage payments ordered by courts, wage adjustment boards, etc.

In an effort to find out how much these fringe benefits cost us, a questionnaire covering the year 1952 was sent to the mining and smelting operations in the Coeur d'Alene district. Of the 19 operations reporting 16 were mining and milling, one was engaged in exploration only, two were smelters. The 16 mining and milling operations in 1952 treated 1,857,134 dry tons of ore having a gross value of $50,148,126.

Table I summarizes the direct wage payments, including overtime and incentive bonuses.

Following approximately the

This is a paper presented by Mr. Brown at the 50th anniversary meeting of the Idaho Mining Association, Sun Valley, Idaho, July 13, 1953.

classification system of the U. S. Chamber of Commerce, Table II details the non-wage payments as dollars per year, per shift, and per hour. We believe that this presents the costs more strikingly than the method used in U. S. Chamber of Commerce Bulletin "Wage Supplements," where they are expressed as percent of payroll.

Especially noteworthy is the payment for time not worked. Our tabulation includes only vacations and holidays, but it amounts to 50¢ per shift. The paid lunch period (nominally a half-hour) universally allowed to underground employees should really be included in this category. However, it was felt that it would be too difficult to segregate or estimate for most operations. A rough estimate would be about 5¢ per hour or 3% of payroll. In any future studies an effort should be made to segregate this item, together with others similar, such as clean-up time and travel time.

We have no previous study in Idaho with which to compare our figures to show how fringe benefits have increased in recent years. However, the U. S. Chamber of Commerce Bulletin "Wage Supplements" lists a "Primary Metal Industries" group, comprising 36 companies throughout the United States. It is interesting to compare our 1952 figures with their 1949 figures, in Table III.

Payroll Costs Up 51%

This table demonstrates why we believe that these costs should be expressed in dollars and cents rather than in percentage of payroll. Because of increased straight-time wages and changes in the proportion of overtime, the percentage of payroll has increased only 8.3% from 10.9 to 11.8. Yet the actual costs in dollars and cents have increased 33% and 51%.

We estimate the direct payroll for mining and smelting in the whole state of Idaho to be about $30,350,000. If we assume that non-wage items amounted to 11.8% of the direct payroll, as in Shoshone County, it means that the mining and smelting industry of Idaho paid out $3,580,000 for these fringe benefits over and above the cash wages in 1952.

Now we are ready to answer the original question, "How much do you pay for a miner?" We can assume that a stope miner is the average employee, therefore he gets the average daily wage (including overtime and bonuses) given in Table I, that is $15.94. In addition, we have shown in Table II that he receives non-wage benefits costing $1.89 per shift. Add this to $15.94 and we find that stope miner costs you not $13.54 but $17.83 per day. There you have $4.29 per shift, or 53¢ per hour, which you do not think about when you look at the wage schedule. In future operations it would be well to keep this real cost in mind.

Table I: Direct Wage Payments (Including Overtime and Incentive Bonus) By the Mineral Industry in Shoshone County, Idaho, 1952

Number of operations reporting	19
Average number of employees covered	4,349
Total shifts worked	1,212,695
Total direct wage payments	$19,326,929
Average annual wage	$4,444
Average weekly wage	$85.46
Average daily wage	$15.94
Average hourly wage	$ 1.99

Table II: Non-Wage Payments by the Mineral Industry in Shoshone County, Idaho, 1952

Item	Total Payments	Per Employee Per Year	Per Shift	Per Hour
I. LEGALLY REQUIRED PAYMENTS (Employer's share only)				
a. Social Security	$240,448	$ 55.29	$0.198	$0.025
b. Unemployment compensation	184,217	42.36	.152	.019
c. Workmen's compensation	354,175	81.44	.292	.036
d. Hospital coverage for employee	145,840	33.53	.121	.015
SUB-TOTAL	$924,680	$212.62	$0.763	$0.095
II. PENSIONS AND OTHER AGREED-UPON PAYMENTS (Employer's share only)				
a. Pension costs	$395,223	$ 90.88	$0.326	$0.041
b. Non-occupational insurance, family hospitalization	153,727	35.35	.127	.016
c. Group life insurance	21,327	4.90	.017	.002
SUB-TOTAL	$570,277	$131.13	$0.470	$0.059
III. PAYMENTS FOR TIME NOT WORKED				
a. Vacation pay	$364,985	$ 83.92	$0.301	$0.038
b. Holiday pay	233,731	53.75	.193	.024
SUB-TOTAL	$598,716	$137.67	$0.494	$0.062
IV. MISCELLANEOUS FRINGE ITEMS				
a. Transportation (Buses)	$100,914	$ 23.20	$0.083	$0.011
b. Misc. social contributions	93,593	21.52	.077	.009
SUB-TOTAL	$194,507	$ 44.72	$0.160	$0.020
TOTAL NON-WAGE PAYMENTS	$2,288,180	$526.14	$1.887	$0.236

Table III: Non-Wage Payments by the Mineral Industry in Shoshone County, Idaho, for 1952 Compared with U. S. Chamber of Commerce Data on Primary Metal Industries, 1949

Item	1952	1949	% Change
NON-WAGE PAYMENTS AS:			
Percent of Payroll	11.8%	10.9%	+ 8.3%
Cents per hour worked	23.6¢	17.7¢	+33.3%
Dollars per year per employee	$526	$348	+51.1%

KEEPING TAB ON PRACTICE

All photos by Gavin Gordon, *Brussels*

OUTSTANDING NOVELTY about Stenuick drill, here seen in Belgian quarry, is that percussive hammer, in which four-point carbide bit is directly inserted, goes down hole with bit. Air is supplied to hammer via column of steel tubes attached to air motor above. Motor rotates column and hammer, also unscrews tubes when column is being lengthened or dismanteled. Motor is seen disconnected in picture at right, tube having just been added.

Novel Drill Is Fast With Deep Vertical 4-in. Holes

A BREAKING AWAY from existing big-hole blasting practice is indicated by the development of a rock drill of a new type which, it is claimed, is revolutionizing the technique of hard-rock quarrying. This drill, known as the Record H.S. deep rock drilling machine, has been developed by a Belgian firm, Ateliers Stenuick Frères, of Fontaine l'Evêque, near Charleroi, in conjunction with Henry Heirman, engineer, of the quarry company Carrières Unies de Porphyre which has its chief production at Lessines and Bierghes-lez-Hal.

Development of the new drill followed on Heirman's calculations evaluating the obvious improvement in fragmentation from a given charge if the few big blast holes can be replaced by a greater number of holes of smaller diameter. Previously, Belgian quarry engineers had had to choose between the holes, 8-in. and larger, produced by various well-known drills with which adequate depth was attainable, and the 2-in. holes of the wagon drill which would go to a depth of 40 or 50 ft.

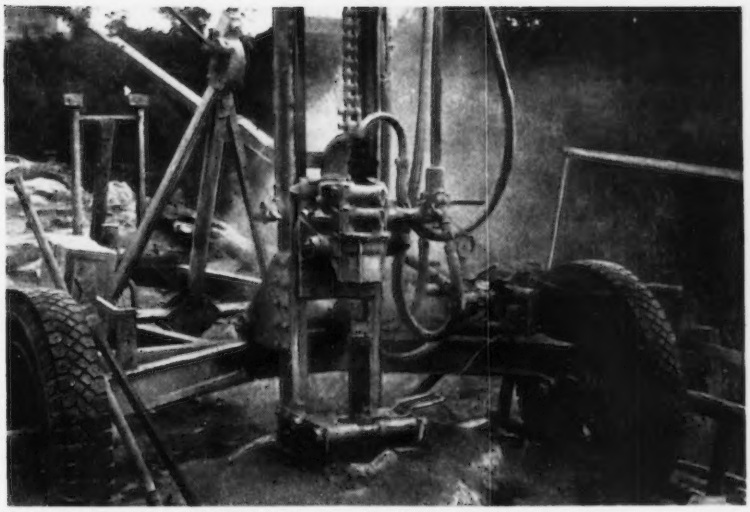
A 4-in. Hole

The Record H.S. drill bores a hole 4-in. in diameter. Though this is twice as large as the wagon-drill hole, it has the advantage that it will drill, and has drilled, down to 140 ft. depth in hard rock. The limit to the depth that can be achieved is not yet known. Plans are ready for drilling down to 165 ft. in the particularly hard rock of the Quenast quarry near Enghien, where the crushing strength is as great as is known anywhere, varying from 40,000 to 60,000 psi. So far as is yet known, the only factor limiting the depth is the ejection of the cuttings (crushed to about minus 125-mesh). This is done by the compressed air, which first activates the hammer, secondly cools the drill-head and finally exhausts up the borehole, carrying the rock-dust with it. Obviously there is some limit to the distance which the air, starting with a pressure of 70 psi, will lift the cuttings; but M. Mahieu, manager of the Quenast quarry, says there was no sign of it being even in sight when the drill-head was at 140 ft. depth.

Hammer Descends in Hole

The depth of the hole is obtained by the outstanding technical novelty that the hammer descends into the hole with the drill. The absorption and dissipation of force, incidental to the transmission of the hammer blow through a series of rods (as in the wagon drill) is thus avoided. The hammer is placed immediately behind the drill-head, every blow falling directly on the head. Connection between the hammer and the above-ground rig is provided by a series of steel tubes, each 9 ft. 10 in. long and weighing 42 lb., which serve as ducts for the compressed air supplied to the hammer-head complex at the bottom.

The column of tubes rides on a vertical mast. It is coupled at its top to a small compressed-air motor, the function of which is to keep the column in rotation (at a speed determined by the nature of the rock being bored), and to unscrew the tubes when the column is being lengthened or dismantled. The motor has a movement of as much as 11 ft. 5 in. on the mast. As drilling proceeds, the column is lengthened by adding another tube. The column, to avoid buckling, is chain-suspended over a winch, and counterpoised by a system of weights which is increased as the column is lengthened. A second small motor by



CLOSE-UP OF COMPRESSED AIR MOTOR, coupled to top of tube column, the percussive hammer and drill bit being down hole at lower end of column. Motor rotates column, unscrews tubes when necessary. It has almost reached bottom of gallows, near time for adding another tube.

TO AVOID BUCKLING OF COLUMN it is chain-suspended and counterweights, seen on mast, are used. Weights added as column lengthens.

the winch serves to raise the column as required, either at the end of drilling or for inspection of the drill-head.

The hammer system is 31½ in. in length and 70 lb. in weight with the fitted shock absorber. It is essentially a cylinder of 3½ in. external diameter (as compared with 2¾ in. for the tube-column) and an internal bore of 1 5/16 in. (50 mm.) in which the percussive piston has a stroke of 5⅞ in. (150 mm.). The drill-head is boited directly into the hammer-cylinder. It has no independent movement, the whole system rotating with the tubes. A simple system of reciprocating valves admits the air to raise the piston and cool the drill-head, subsequently exhausting with the pulverized cuttings.

Cross Bit With Carbide Insert

The drill-head, of hardened steel, is made in the form of a cross presenting a lateral face over about 180° of circumference. Working results have shown loss of diameter of under half a millimeter as normal after boring to 40 meter (130 ft.) depth. The leading edge is bevelled to the center line of the arms of the cross, which is provided with a four-point tungsten-carbide insert.

Up to the present the drill-head appears to be the chief point on which improvement may, with further study, become possible. The makers give a guarantee of 100 meters (328 ft.) of drilling; and, though in practice many heads do much more than this, the cost of replacement is such —utilization being so far confined mostly to hard-rock quarries—that it is not yet practicable to extend the guarantee. In the porphyry at Bierghes, Heirman has obtained slightly more than 410 ft. as an average life of head. In the much harder porphyry at Quenast, Mahieu's best life was about the same figure, the head having been raised for sharpening after every 9-11 meters (30-36 ft.). The replacement cost of the drill head in Belgium is $80.

Drilling Speed 8 to 10 fph.

The drilling speed in hard rock is said in the specifications to be 2½-3 meters (say 8¼-10 ft.) per hour. In the Bierghes porphyry, Heirman states, 10 fph is about the actual speed of penetration (without allowing for stopping for raising head and lengthening column). In drilling five holes of 128 ft. each at the same company's Lessines quarry, a total of 640 ft. of drilling, the total time was 100 hours. This, however, included the time taken for moving the drill. In the super-hard rock at Quenast, penetration is at the rate of about 5 ft. 9 in. per hour, which compares with something under 2 ft. averaged by a churn drill at the same quarry which makes a bigger hole in the same rock.

As to operation, the only limiting factor seems to be water which, of course, makes the action of the hammer impossible. In this respect the Record H. S. drill is at a disadvantage compared with churn drills, inasmuch as it is necessary to abandon a hole if it runs into water that cannot be removed.

Less Secondary Blasting

The first advantage claimed for the Record H.S. drill is quick deep drilling at a convenient diameter. Mahieu comments on the improvement in fragmentation resulting from the fact that the holes can be filled with charge to 50% or over, as compared with only an average of 28% for the bigger holes made with the churn drill. Heirman's calculations are based on the assumption of varying the number of holes, but retaining a practice of charging up to two-thirds the height—the total charge remaining constant. This throws doubt on the effective fragmentation sideways, as opposed to the upper layer of the rock, but in either case the result is the same. The advantage of the smaller holes, and the better fragmentation, is to reduce the amount of re-blasting at the quarry bottom, and to improve the operational efficiency of the mechanical shovel which is the essential link between the rock-face and the crushing plant.

The second advantage is simplicity of construction, which leaves nothing to go wrong and concentrates the wear in the drill head. With this is allied extreme simplicity of operation, which greatly reduces the labor cost. No more than a single runner is required for a machine, and one worker can easily mind two machines. All he has to do is note the rotation speeds, insert a fresh tube in the column at intervals, clear away cuttings settling around the hole-mouth, and, as needed, raise the drill head and change it.

On this basis, Mahieu calculates his drilling cost at $3 per meter (92¢ per foot), against $10 per meter ($3.05 per foot) with one of the churn drills. Heirman has had four churn drills at Bierghes, each of which required two men to operate it besides a 15-hp. electric motor. Instead he has installed a single Record H.S. machine, requiring only one operator; and with this he manages to keep the power shovel ahead of the crushing plant. Consumption of compressed air is 70 cfm at 70 psi.

The Record H.S. drill weighs approximately a ton. The mast, when vertical, raises to a height of 16 ft.

Bulldozer Finds Place Underground

CABLE REEL is designed by U.S. Steel's T.C.I. division, Birmingham, to allow free movement of bulldozer throughout mine.

FUSES OF 35-HOLE DRIFT ROUND are connected in any desired sequence to Igniter cord at Inco's Frood-Stobie mine in Sudbury district, Ontario, so that entire round may be blasted by lighting single fuse. High degree of safety thus obtained is principal objective, use of cord having proved safer than electric blasting. Type of cord used in drifting burns at rate of 1 ft. per 20 sec. Another type, for stoping, burns at rate of 1 ft. per 8-10 sec. Slotted connector attaches each fuse to cord.

THE BULLDOZER has gone underground at the TCI mines of U. S. Steel Corp. in Birmingham, with surprising efficiency. So many uses are being found for it that four have been put into service, two at Winona and one each at Muscoda No. 6 and Limestone (Muscoda No. 5).

The bulldozers, crawler-mounted, are operated by electric motor. TCI designed and built the cable reels, which are mounted on the rear end. A conventional blade is used. The Caterpillar D-6 machines at Winona and Muscoda are fitted with a removable hook on each side to carry crossties when extending rails. This is safer, faster, and takes less effort. The bulldozer underground can do as good a job as it can above ground.

TCI's big objective was to obtain immediate maximum loading of the muck after shooting. Rough roadways moreover, are hard on tires and rolling equipment. A smooth roadway means faster and safer travel.

After the round is blasted the bulldozer moves to the face, piles the muck up quickly, clearing the roadway as it moves forward. The loader can then move into position and start loading at top speed. This means 15% to 20% more tonnage than before.

TCI estimates that, with the bulldozer piling the muck, a heavier cut can be made which would increase the tonnage. Any loose rock or ore near the face or in roadway can be moved forward easily for loading.

The bulldozer moves from panel to panel as needed, to pile muck or to clear roadways. It is also used for grading, making fills or repairs as needed.

Fifty-Ton Truck Has Wide Field Experience

ANTICIPATING THAT THE TREND toward larger sizes of loading shovels and heavy-duty trucks current on the Mesabi Range two years ago would continue, Euclid Road Machinery Co. introduced an experimental 50-ton rear-dump truck, Model 1LLD, in July 1951. This truck hauled stripping for M. A. Hanna Co., first at the South Agnew mine, later at the Carlz. It has seen several thousand hours of field service. It is finding use elsewhere also, and is now a standard item.

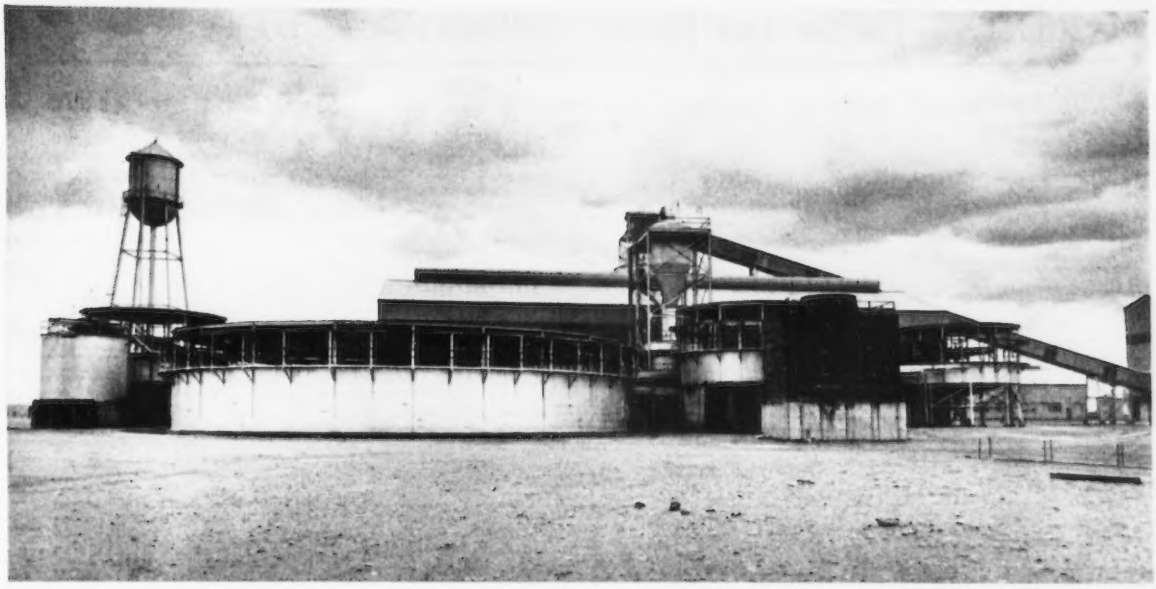
As a result of field experience, improvements have been made. The 50-ton rear-dump unit employs a power transmission design used on Euclid's 34-ton rear-dump tandem-axle trucks. It is powered by two 300-hp. Cummins diesel engines, which provide a desirable ratio of horsepower to gross vehicle weight. Each engine drives its axle through an Allison torque converter and torqmatic transmission. The unit has a 32-cu. yd. (struck-measure) body, which is heated by the engine exhaust, thereby preventing winter freezing. The unit has ten 18:00 x 33, 32-ply tires which give ample carrying capacity for the load.

4 in.; when lowered, it projects beyond the 11-ft. chassis to a distance of 15 ft. 8 in., the height being now under 4 ft. The overall width is 6 ft. 10 in., and the wheelbase 6 ft. 6 in. on two front wheels (600/20 tires) and a single rear bogey (450/12).

•

USE OF PHOSPHATE in its drainage system was started by United States Smelting, Refining & Mining Co., at Bayard, N.M. to clean out the water colums and prevent deposition of lime.

Flexible plastic pipe, 4 in. in size, is being tried in the same mine to drain water rings in the shaft where pressures were nil or under 50 psi. The flexibility secured by using plastic pipe has proved to be a great convenience.



Overall view of the plant with a 120′ dia. Dorr Thickener in the left foreground handling flotation tailings. A 40′ dia. Dorr effluent Thickener and 40′ dia. Dorr Hydroseparator are at the right. All three units are covered to prevent temperature increases resulting from the sun's rays.

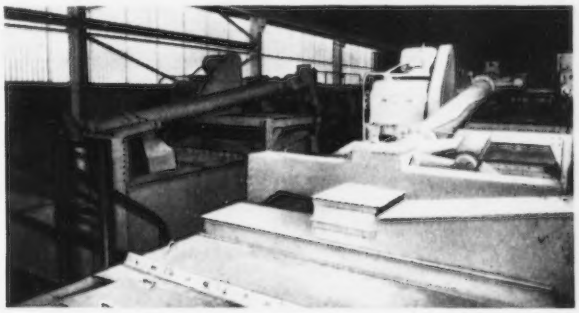
NEW MEXICO POTASH PRODUCER

Combines Chemical and Metallurgical Techniques at New Plant . . .

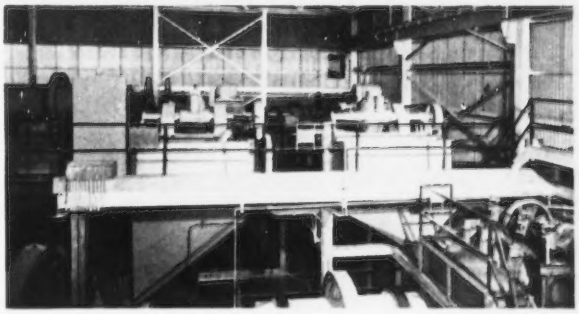
A new U. S. producer for the quality potash market, Duval Sulphur & Potash Company recently started up this modern plant near Carlsbad, New Mexico. A perfect example of the growing convergence of chemical and metallurgical techniques, the plant makes skillful use of the latest developments in both fields.

The flowsheet includes crushing, grinding, classification, hydroseparation, flotation, thickening, centrifuging, crystallization and drying.

At Duval, as throughout the chemical and metallurgical industries, Dorr equipment and techniques play a vital part in wet processing flowsheets. For more information on the scope of the Dorr technical service, write for bulletin No. 7002. The Dorr Company, Stamford, Conn. *In Canada:* 26 St. Clair Avenue, E., Toronto 5.



Closeup of two Duplex Dorr HX Classifiers. The Primary at right handles raw crushed salt which has been pulped with return brine. Sands go to a rod mill and fines to the Hydroseparator.



General view of the milling section. Rod mill discharge goes to the Secondary Classifier at the right. Sands are discharged to conditioners and fines overflow to the Hydroseparator.

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Stocks of Refined Copper Increasing

As expected, deliveries of refined copper declined during the vacation month of July and stocks increased by 18,974 tons. A summary of the latest statistics of Copper Institute, figures in short tons, follows:

UNITED STATES

Production:	Year 1952	Jan.-July 1953	June 1953	July 1953
Crude primary	961,886	558,143	75,838	80,958
Crude, secondary	46,003	71,979	9,110	8,026
Totals	1,007,889	630,122	84,948	88,984
Refined copper	1,189,112	789,203	124,480	112,570
Deliveries, refined (a)	1,445,834	908,409	139,520	104,593
Stocks at end, refined	58,858	77,100	58,126	77,100

OUTSIDE UNITED STATES

Production:	Year 1952	Jan.-July 1953	June 1953	July 1953
Crude, primary	1,401,001	865,957	132,522	127,368
Crude, secondary	9,582	7,280	717	430
Totals	1,410,583	873,237	133,239	127,798
Refined copper	1,196,426	672,756	104,137	84,149
Deliveries, refined (a)	1,005,259	485,257	74,198	68,128
Stocks at end, refined	130,103	166,306	154,836	166,306

(a) Deliveries to fabricators.

Slab Zinc Stocks Up

Though production of slab zinc at U. S. smelters declined moderately during July, total shipments also were off and stocks increased by 6,621 tons. Stocks as July ended totaled 103,906 tons, which compares with 87,160 tons on Jan. 1 of the current year.

A summary of the June and July Statistics of the American Zinc Institute, in tons, follows:

	June	July
Stock at beginning	92,452	97,285
Production	81,617	80,825
Production, daily rate	2,721	2,607
Shipments:		
Domestic	72,612	69,498
Export-drawback	36	94
Government acc't	4,136	4,612
Totals	76,784	74,204
Unfilled orders	44,307	32,327
Stock at end	97,285	103,906

U. S. consumption of slab zinc in May totaled 88,425 tons, down 3% from April, the Bureau of Mines reports.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated

MISCELLANEOUS METALS

Aug. 31, 1953

Aluminum ingot, 99 plus percent, lb.	21½¢.
Antimony, spot, lb., 5 tons and up but less than carload, packed in cases	37.97¢.
Bismuth, ton lots, lb.	$2.25
Cadmium, commercial sticks, delivered, lb.	$2.00
Calcium, lb., ton lots, 98 percent, cast	$2.05
Chromium, 97 percent grade, lb., contract	$1.18
Cobalt, 97 to 99 percent, per lb.	$2.40
Germanium, lb.	$340.00
Indium, troy oz.	$2.25
Lithium, lb., 98 percent	$11.00 @ $14.00
Nickel, cathodes, lb., f.o.b. Port Colborne (a)	60¢.
Magnesium, 99.8 percent, carloads, lb., producer's plant, Freeport, Texas	27¢.
Palladium, troy oz.	$23.00 @ $24.00
Platinum (Official quotation wholesale lots) troy oz.	$92.00 @ $93.00
Quicksilver, flask of 76 lbs., 25 flasks or more	$188 @ $191
Selenium, 99 plus percent, lb.	$4.25 @ $4.75
Silicon, minimum 97 percent, carloads, lb.	18½¢.
Tellurium, lb.	$1.75
Thallium, 100 lb. or more, lb.	$12.50
Titanium, 99.3 plus, lb.	$5.00

(a) Includes U.S. duty.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per unit	$46.00 @ $48.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry	
44% Cr_2O_3 no ratio	$27.00 @ $32.00
48% Cr_2O_3 3 to 1 ratio	$44.00 @ $56.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer (b)	$10.30
Mesabi bessemer (b)	$10.05
Mesabi, non-bessemer (b)	$9.90
Lead (Galena), 80 percent, Joplin, Mo., ton	$173.70
Manganese Ore—Per long ton unit of Mn basis 48 percent manganese, nearby positions, subject to premiums and penalties, $1.15 @ $1.18 c.i.f. U.S. ports, duty extra. Long-term contract nominal at 90c. to 93c., c.i.f. duty extra.	
Molybdenum Ore, 90%, per lb. of MoS_2 f.o.b. mines	60¢.
Tantalite, 60% concentrate, per lb.	$2.50 @ $3.00
Tungsten Ore, per unit of WO_3	
Foreign, 60 percent, c.i.f. U.S. ports	$42.00 @ $43.00
Domestic, scheelite, 60 percent f.o.b. mill	$63.00
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	31¢
Zinc Ore, Prime, 60 percent concentrate, Joplin, Mo., per ton	$65.00

(a) F.o.b. port of shipment. (b) Effective July 1, 1953.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl. carload lots delivered	5½¢.
Cobalt Oxide, 72½ to 73½%, ceramic grade, per lb.	$1.82 @ $1.84½
Copper Sulphate, 100 lb.	$10.35
Germanium Oxide, lb.	$142.00

ALLOYS

Ferrochrome, 65 to 69 percent, per lb. of Cr contained	24¾¢.
Ferromanganese, 74–76%, net ton, seaboard	$200
Ferromolybdenum, 55 to 65 percent Mo. lb. of Mo. contained	$1.32
Ferrosilicon, 50 percent per lb. of contained Si	12.4¢.
Ferrotungsten, 75 to 80 percent, lb. of W contained	$4.35
Ferrovanadium, per lb. of V delivered	$3.00 @ $3.25
Silicomanganese, Max. 1½ percent carbon, per lb. contracts	11.4¢.
Spiegeleisen, per long ton, 19 @ 21% grade	$86.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:	
Crude No. 1	$960 @ $1,500
Crude No. 2	$595 @ $900
Spinning fibers	$321 @ $514
Shingle fibers	$150 @ $200
Paper stock	$109 @ $137
Waste	$77
Shorts	$35 @ $70
Asbestos, Vermont, f.o.b. Hyde Park:	
Spinning fibers	$279.50 @ $302.00
Shingle stock	$135.00 @ $162.00
Paper stock	$81.50 @ $115.00
Waste, stucco or plaster	$71.40
Refuse or Shorts	$34.00 @ $63.00
Barytes, f.o.b. cars:	
Georgia, crude, per ton	$14.00
Missouri, 94 percent $BaSO_4$, per short ton	$13.25
Bauxite, long ton, f.o.b. point of shipment:	
Domestic, crude, 50 to 52 percent (not dried)	(a) $5.00 @ $5.50
Domestic, chemical, 55 to 58 percent	(a) $8.50 @ $9.50
Domestic, abrasive, 80 to 84 percent	(a) $18.00 @ $18.50
China Clay, f.o.b. mines, ton:	
Georgia, filler and ceramic grades	$8.50 @ $9.50
North Carolina ceramic grade	$20.25 @ $22.25
Feldspar, bulk ton:	
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50 @ $22.25
Glass feldspar, white, 20 mesh	$11.75 @ $12.50
Fluorspar, f.o.b. mines, bulk, 70% effective ton	$42.50
60% effective CaF_2	$38.00
Acid 97% concentrate, bulk, ton	$60.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 @ $14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington	$39.56
Mica—Domestic, f.o.b. mines. Punch 12 to 22¢. per lb. according to size and quality. Sheet clear, 1½ x 2 inch, 80 to 85¢.; 2 x 2 inch, $1.10 to $1.20; 2 x 3 inch, $1.50 @ $1.60; 3 x 3 inch, $1.80 @ $1.90; 3 x 4 inch, $2.20; 3 x 5 inch, $2.40; 4 x 6 inch, $3.15; 6 x 8 inch, $4.25. Wet, ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton Scrap $32 and up.	
Ocher, Georgia, ton, in sacks	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	Not quoted
Sulphur, Texas, mines, long ton	$25.50 @ $27.50
Talc, f.o.b. works, ton:	
New York, purified	$18.50 @ $20.00
Vermont, extra white	$12.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	30.00

(a) Nominal.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces	$56.00
Steel f.o.b. Pittsburgh, billets, net ton	$62.00
Structural shapes, 100 lb.	$4.10

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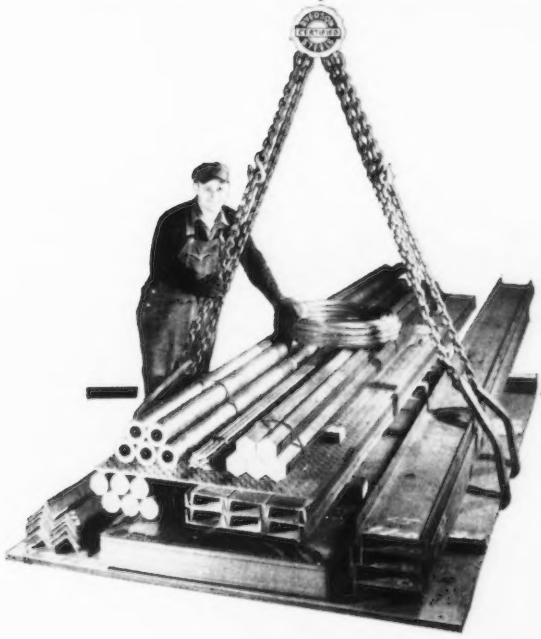

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WASHINGTON IMPACT

Morton A. Reichek, McGraw-Hill Washington News Bureau

Tightened Budget Will Pinch Expansion

BUDGET DIRECTOR JOSEPH DODGE'S celebrated economy order will put a new damper on the Government's metals and minerals programs. Issued on behalf of the White House, the order directs executive agencies to reduce Government spending by at least $4.5 billion in fiscal 1955.

Agencies will begin tapering off spending at once. From now on, Government expenditures will feel a heavier hand than at any time within memory. It's all part of a campaign to stay under the legal debt ceiling and to balance the budget as early as possible.

The economy order will affect both expansion and stockpile programs. The strings will be drawn even tighter on the Treasury's $2.1-billion borrowing authority, which was set up by the Defense Production Act and with which large-scale domestic and foreign mining expansion has been stimulated.

Substantial funds from the authority are still on the books for additional expansion incentives, but ODM will become almost as tight-pocketed about loans, market guarantee agreements, and subsidies as it was during recent mining expansion freeze.

Under the Dodge Economy order, unobligated strategic stockpile funds will be subject to cancellation by Congress if not spent by June 30, 1955. According to most recently published figures, unobligated stockpile money amounted to $300-million, and only 78% of total stockpile objectives were on hand or under contract for future delivery. No new stockpile funds were appropriated for the current fiscal year, and it's now unlikely that additional sums will be voted in the future.

Mining Law Revision Goes Round and Round

REVISION OF THE MINING LAWS may get through Congress next year, but it won't be the kind advocated by New Dealers during the past 20 years. Serious agitation for setting up a leasing system to replace patents on metals claims has vanished. Chances are that administration of mining lands in national forests will be made more restrictive and that assessment work requirements will be hiked.

During the recent session of Congress, the House Agriculture Committee approved the Hope Bill (H.R. 5358), which transfers administration of 133-million acres of national forest lands, now open to mineral entry, from the Bureau of Land Management to the Forest Service.

Mining spokesmen here oppose the Hope Bill, charging that its language is so rigged that it would become "next to impossible for bonafide miners to file claim in the national forests." In effect, the bill created two sets of mining laws—one for the national forests, another for the remainder of the public domain.

The Hope Bill failed to reach the House floor only because a bill covering the same ground—but more sympathetic to mining interests—was reported out by the Interior Committee, the D'Ewart Bill (H.R. 4983). The two committees were directed to settle the differences between their respective bills and send one piece of legislation to the floor. So far they have failed to confer and the issue won't be resolved until next year.

The D'Ewart Bill makes no significant change in mining laws. In fact, many of its supporters say the bill would be unnecessary if present laws had been thoroughly administered.

In recent months, Rep. Saylor (R., Pa.) and Rep. Regan (D., Tex.), both ranking Interior Committee men, have proposed boosts in assessment work requirements. Saylor argues that "$100 in 1872 is not the same as $100 in 1953," alluding to the unchanged rate since passage of the original mining law. Regan charges that "only 3% of the claim holders do any real assessment work" on the public lands at present.

Counter-balancing these potential new mining law restrictions, the House Interior Committee is considering legislation dealing with multiple law of public lands, which would aid the mining industry. Specifically: To permit claim locations, rather than leases, for such minerals as phosphate, sodium, sulphur and potash.

Nowhere on Aluminum Expansion

THE THIRD ROUND of domestic aluminum expansion, which was to boost primary capacity to 1.7-million tons by 1955, has turned out to be a dud. The goal was increased last October by 200,000 tons. Within three months, three would-be producers were certified for accelerated tax amortization: Olin Industries, Inc., for a $123.3-million plant with 110,000 tons capacity; Harvey Machine Co., $65.2-million, 54,000 tons and Wheland Co., up to $70-million for a plant to produce at least 50,000 tons.

Only Harvey had a firm plant site and power commitment—at The Dalles, Ore., near Bonneville. Only Harvey has been able to get started. The company has a GSA market guarantee and has begun construction. Olin and Wheland, however, have been unable to obtain adequate private financing to start operations. They need Government loan guarantees, by form of assistance which the third round did not provide.

From this point, the Olin-Harvey fortunes take on the appearance of a roller coaster. In June, while ODM was considering the issuance of loan guarantees, Alcan worked out sales of 600,000 tons primary aluminum to Alcoa, 186,000 tons to Kaiser. The tonnage represented by the deals exceeded the Olin-Wheland potential over the next six years. So ODM turned thumbs down on the companies' request for additional aid.

The next month, however, the Justice Dept. unexpectedly ruled that the Alcan-Alcoa deal was an anti-trust violation and petitioned the court to cancel the sale. Cancellation would put a crimp in Alcan's expansion for low-cost aluminum output at Kitimat. And so there was new talk in Washington about additional help for Olin and Wheland.

Late last month, the problem was tossed into the lap of the Defense Mobilization Board, ODM's Cabinet-level advisory group. Their decision: Postpone further action until the new Joint Chiefs of Staff review the military goals. The prospect is that a substantial revision may be made, which would cut future aluminum requirements and discourage additional government financial aid to new domestic producers despite a growing civilian market.

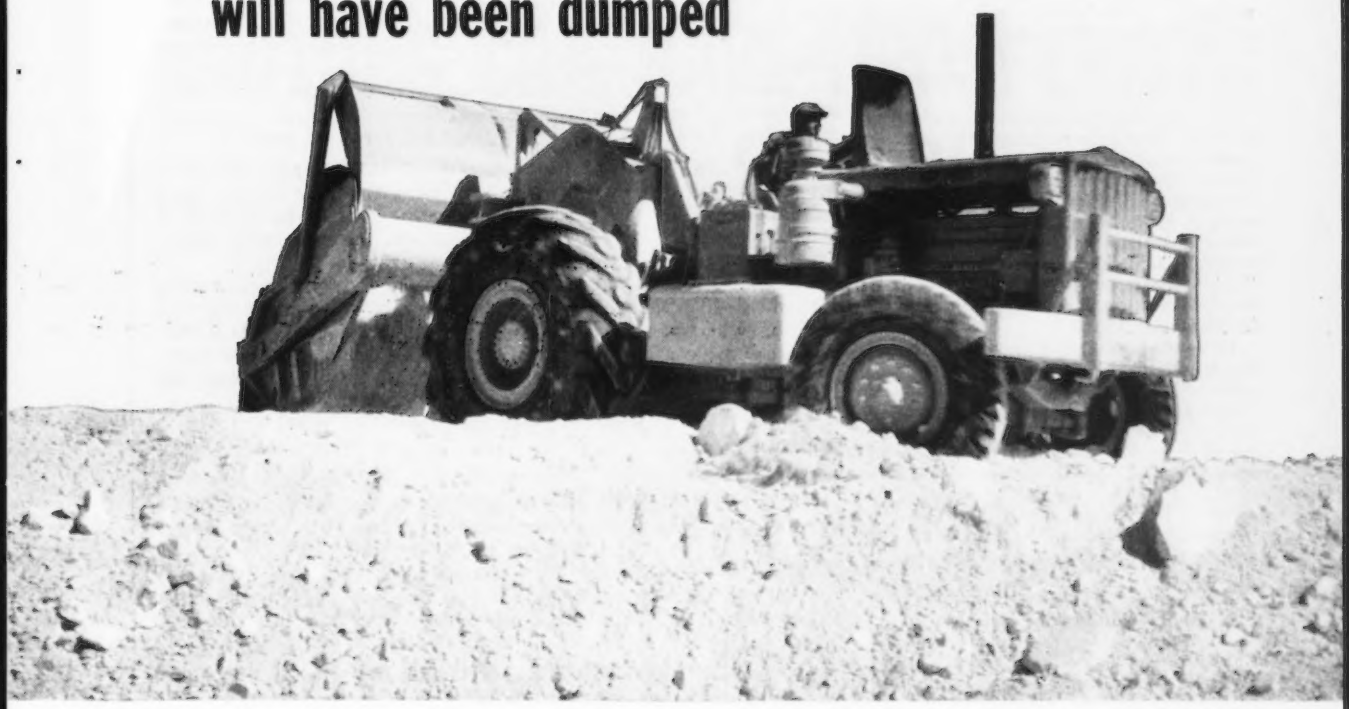
In the meantime, Harvey has encountered a new snag: Bonneville has been unable to get $1-million appropriations to build a transmission line to Harvey's plant.

In an action that may or may not be related, Harvey has applied to the Federal Power Commission for permission to make a preliminary survey for construction of a 1.4-million hp. hydro project on the Copper River in Alaska to power an electro-metallurgical plant.

The outlook for more domestic aluminum expansion has been made even darker by a new Interior Dept. policy on power, which puts the kibosh on additional cheap power for industrial consumers.

(*Continued on page 110*)

By the time you finish the first paragraph, 22 yds. of Dicalite will have been dumped



In mining, speed is profit. That's why the machines working for Great Lakes Carbon Corp., Los Angeles, Calif., are high-speed Caterpillar DW20 Tractors with matching No. 20 Scrapers. Carrying 22 loose yds. of Dicalite from pit to stockpile near Lompoc, Calif., these brawny units have a spreading time of *15 seconds*.

Each of Great Lakes Carbon's three DW20 units whips through seven trips an hour on a 1.2-mile haul. In one 10-hour day, the trio haul 4,620 yds. of Dicalite to the stockpile.

Unusual performance? No, sir! This unit is expected to deliver because it is all-Caterpillar built—every part created specifically for this type of work. There's extra power and capacity built into the Cat* DW20 Tractor and No. 20 Scraper team. The 225-HP engine in the tractor precisely balances the scraper's capacity to give sustained, long-haul, high-speed, low-cost service.

Quick spreading of any material results from the scraper's high apron lift and positive ejection. Combine this with its cable controls and you are positive of fast, sure loading and spreading.

But, just as important, this equipment is built for a long, productive life. Let your Caterpillar Dealer demonstrate these profit-building units. They're worth looking into.

Caterpillar Tractor Co., Peoria, Illinois.

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Does Lack of Headlines Slow Mineral Probe?

SINCE THE NOVEMBER ELECTIONS, Washington has heard serious talk about Congressional investigation of the metals and minerals expansion and stockpile programs. But so far nothing constructive has been accomplished, and the outlook is for more of the same. Last month, Sen. George Malone, chairman of the Senate Minerals Subcommittee, announced an investigation "to determine American access to strategic raw materials, with special reference to American self-sufficiency during wartime conditions."

William B. Ziff, publisher-economist-military theorist, was named the subcommittee's executive advisor, and Joseph Keenan, prominent Washington lawyer and chief war crimes prosecutor in Japan, was appointed general counsel. Malone said public hearings would be held this month. Presumably this investigation was to be an extension of a similar study announced by Malone in March.

It now appears, however, that the investigation—like a similar probe started this year—has fizzled. Hearings have been delayed, and it has become obvious that there's uncertainty on how the investigation will be handled. According to the committee's staff, the delay is caused by a recent accident to Malone, which has hospitalized the Nevada Senator. But observers think there's something else involved.

Prior to Malone's announcement, Sen. Joseph McCarthy, chairman of the Senate's Government Operations Committee, revealed that he had been investigating Government metals stockpiling for three months, and announced that he would hold public hearings in mining states to determine whether the mining industry had been "injured" by the program. Then McCarthy called off his probe. He has turned over his stockpile files to Malone, and has detailed one of his ace investigators to become the minerals subcommittee's assistant general counsel. Later McCarthy showed up in San Francisco to hold stockpile hearings on his own, but on behalf of Malone. These events have created considerable skepticism among some mining experts here. They feel the probers are more interested in political scandals than in legislative proposals beneficial to mining and the national security.

They believe also that more competent probes could be made by the Armed Services Committee, where stockpiling legislation was written, or the Banking and Currency Committee, which has jurisdiction over statutes creating the expansion program. If sufficiently juicy political scandals are not uncovered, the feeling is that Malone's investigation will simply produce "just another academic tariff treatise."

LABOR THIS MONTH

Joseph M. Gambatese, McGraw-Hill Washington News Bureau

COMMUNISTS IN UNIONS: The Senate Internal Security Subcommittee's "task force" on infiltration of subversives in labor unions will begin its exposure in late October. Hearings will be in Washington, Pittsburgh, Cleveland and other parts of the country. Object: To have a report ready for the next session of Congress in support of Senate Bill S 1606 introduced by Sen. Butler of Maryland.

This bill to cope with Communist-dominated unions like Mine, Mill and Smelter Workers follows the pattern of the McCarran Bill, with this difference: It would deny Taft-Hartley protection immediately to any union accused of being under Communist control, pending hearing and final decision by the Subversive Activities Control Board. The "task force" consists of Sen. Butler, chairman; Sen. Walker of Idaho and Sen. McCarran of Nevada.

MINING SETTLEMENTS FOLLOW STEEL: Nonferrous mining and smelting companies were matching the 8½¢ hourly wage increase in basic steel at presstime. Major strike by Mine-Mill seemed averted, as forecast. Some sweetened the raise with fringe benefits costing less than a cent or two.

Kennecott's Utah copper division gave no fringe improvement, but added 4.2¢ to the 8½¢ as an "equalizer" to make up the difference between past wage settlements made with Mine-Mill and those made with CIO steel workers. Thus, the total boost came to 12.7¢, part of it going to widen the differential between job grades from 42¢ to 44¢ a shift.

Mine-Mill is calling it a 9¢ "pattern." The rival CIO steel union settled for 8½¢ with basic steel in June. Steel contracts were open only on general wage increase.

MINE-MILL MEETS IN ST. LOUIS: Attacks on the mining industry, the Eisenhower administration, the 83rd Congress and even the CIO and AFL will be heard from the 49th convention of Mine, Mill and Smelter Workers, opening Sept. 14 in St. Louis. Current officers are expected to be nominated and re-elected in referendum later. Thus left-wing control will continue, unchallenged.

TAFT-HARTLEY MERRY-GO-ROUND: Don't count on Congress to revise the Taft-Hartley Labor Law even next year. The pro-labor "draft" of amendments that leaked out of the White House widened the gulf between labor and management positions and warmed up controversy over the law. Taft-Hartley supporters in Congress are forcing the White House to back down. Labor won't like it. It looks like another hot fight in the next session of Congress, with a good chance that nothing will be done. That would keep Taft-Hartley as an issue in next year's Congressional elections.

FERMENT WITHIN ORGANIZED LABOR: Who will take the places of Lewis, Green and Murray as the real leaders of organized labor during the next 20 years? The answer to that question lies behind much of the dickering, shifting and other maneuvering among labor leaders today. George Meany and Walter Reuther have taken over leadership of AFL and CIO, but have yet to consolidate their positions. Teamster Dave Beck and steel boss Dave McDonald are breathing down their necks. We look for Meany and Reuther to strengthen their grasp, become stronger leaders than Green and Murray. No third labor federation is in the offing.

OFF A LABOR REPORTER'S CUFF: CIO steel union net worth has reached $10,855,697. . . . AFL claims more than 10-million members, about double CIO. . . . CIO is sponsoring daily newscast by John W. Vandercook over ABC radio network. AFL has had Frank Edwards on Mutual network for several years. . . . Congress cut Labor Dept. spending $4,700,000, hitting wage-hour enforcement most. . . . New Udylite Corp. contract with CIO auto union lets workers keep pension rights after 10 years.

BRITONS CAN HAVE PROSPERITY —If They Want It

What is required to get Britain, our key ally in the grand alliance of the free world, firmly back on her economic feet? The purpose of this message is to throw light on this crucial problem, which afflicts our other European allies also.

At the moment, Britain is enjoying a respite from the economic crises (of 1947, 1949 and 1951-52) which have plagued her postwar course. This respite may well continue for some time. But almost no one whose judgment is trustworthy believes that Britain has acquired sufficient economic strength to safeguard her against further economic crises in the years immediately ahead.

Two British Views

New and clear light on what should be done to that end has recently been shed by two noteworthy British publications. One is a book, "We Too Can Prosper," by Graham Hutton, distinguished British economic writer and administrator. The other is an article, "The Riddle of Prosperity," published by THE (London) ECONOMIST, Europe's most eminent economic journal.

Combined, these two publications present in sharp relief the basic problem that must be handled successfully if Britain is to be safely solvent. As is implied by its title, ***the Hutton book demonstrates that Britain can be made prosperous by readily feasible procedures, patterned on what has been done in the United States, to increase its industrial efficiency. But, says THE ECONOMIST, with Mr. Hutton's book in mind, this is not the most basic problem, which is, "How shall we make the British people determined to be prosperous?"*** This is a problem of incentive or motivation.

Compared with that of the United States, average industrial efficiency in Britain, as in most of Western Europe, is low. In his book Mr. Hutton remarks that "fifty years ago an American industrial worker turned out roughly the same amount in a day as his opposite number in Britain, Germany or France. . . . Today, he turns out from two to five times as much."

In large part it is this lag in output per hour or "productivity," as the technicians call it, which makes Britain and other key countries in Western Europe a continuing prey to economic crises. Moreover, the great disparity in productivity between the U.S.A. and most

of Western Europe is a major barrier to knitting the free world into a smoothly working economic whole. As one observer put it, "when the American economy catches a cold, the European economy gets pneumonia." This is largely because Europe is so much weaker in productive strength.

No Shortage of Knowledge

Yet the knowledge which would enable the countries of Western Europe, and particularly Britain, to increase their industrial productivity has been mobilized and is readily available to them. It is with this process for Britain that Mr. Hutton's book is concerned. In the book he summarizes the findings and conclusions, virtually all of them unanimous, of 66 teams, composed of British industrial managers, technicians, shop workers and labor leaders. Over a period of three years these teams completed a comprehensive series of inspection and study trips in the United States under the sponsorship of the Anglo-American Council on Productivity. The product of that effort, he remarks, is "a set of documents the like of which, on such a scale and of such practical value, has never been seen in the history of international and cultural borrowing."

Psychology the Key

From study of these documents, Mr. Hutton concludes that better capital equipment is the key technical ingredient of higher industrial productivity in Britain, and constitutes "the most urgent . . . need of British industry." But he finds that ***even without new capital equipment a "15% rise in productivity can still be achieved by reorganization of work," and that such an increase would "solve Britain's chief social and economic problems."***

Then why is not such an increase in productivity, demonstrated by the Anglo-American productivity teams to be so clearly within technical grasp, promptly forthcoming? Mr. Hutton, quoting one of the team reports, remarks that, ***"'the greatest obstacles to increased productivity are psychological rather than technical.'*** We have to deal first and foremost with men, not machines." And THE ECONOMIST, pursuing the line of inquiry suggested, reaches the conclusion that, by and large, the people of Britain do not want to prosper by being more efficient. THE ECONOMIST says:

> "The real secret of American productivity is that American society is imbued through and through with the desirability, the rightness, the morality of production. . . . But in Britain, if any moral feeling at all survives about economic matters, it is usually a vague suspicion that economic success is reprehensible and unworthy. From this difference in attitudes everything else follows."

"How," asks THE ECONOMIST, "shall we set about restoring some belief in the rightness of effort, the morality of success?" For this question it has no ready answer. Neither have we. We are confident that the British people will neither be cajoled nor coerced into trying to match our productivity. Basically the problem seems to be to demonstrate clearly to them the truth of the proposition, set down by Graham Hutton, that "there is no goal, aim or end before a Good Society which the raising of that society's material productivity cannot render easier of achievement." Doing that in an old and settled country like Britain is obviously an extremely formidable undertaking. But ***until it is done, the crucial job of getting Britain and the rest of Western Europe firmly on its economic feet will remain to torment all of us.***

McGraw-Hill Publishing Company, Inc.

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A Progress Report on the Status of FluoSolids

Applications of Non-Catalytic Fluid Techniques Expanding into Many New Fields

Pioneered by Standard Oil Development Company during World War II, fluidization is today widely recognized as an ideal means of promoting intimate contact between solids and gases. As licensee in all non-catalytic non-hydrocarbon fields, The Dorr Company has continually expanded the applications of this new technique since 1944. At the present time, FluoSolids is demonstrating outstanding advantages in the processing of a wide variety of metallic and non-metallic minerals, and holds great promise for the future in other fields not yet fully developed.

GOLD

One of the first applications of the Dorrco FluoSolids System was the roasting of arsenopyrite gold ores prior to cyanidation, and several installations have been operating with marked success for two to five years. Latest development for gold roasting is the split compartment Reactor. In this type of unit, preliminary reducing conditions are provided in one half of the Reactor and a complete oxidizing roast in the other, resulting in decreased cyanide consumption and better metallurgy at the mill.

PYRITE

The sulfur shortage has contributed to great activity in the pulp and paper field. Eight FluoSolids Systems in the U. S., Canada and Norway are either in operation or under construction in sulfite pulp mills, for the production of SO_2 for cooking liquor. Eight more are in operation or being installed to produce SO_2 from pyrite, pyrrhotite and low grade sulfur ores at acid plants, which will produce over 1200 tons per day of H_2SO_4 by the contact method. This impressive record results directly from the fact that FluoSolids can deliver a high strength SO_2 gas at lower investment and operating costs than conventional roasters and provides users with an economically feasible and reliable source of SO_2 despite fluctuations in natural sulfur supply.

ZINC

The first commercial FluoSolids installation for the roasting of zinc concentrate went into operation in the summer of 1952. It is producing SO_2 gas for sulfuric acid manufacture and a desulfurized zinc calcine for leaching, prior to electrolytic zinc production. Results to date have demonstrated marked simplicity of control and operation, and two other zinc producers have ordered similar Systems.

COPPER

More recently, the first FluoSolids System to provide a sulfating roast to a copper-zinc concentrate went into operation. In this application, close operating controls make it possible to render the valuable base metals soluble and, at the same time, minimize solubility of the iron. This permits high recoveries of copper and zinc by leaching. When followed by electrolytic precipitation, economic advantages are indicated under many conditions as compared with conventional smelting practice.

NEW DEVELOPMENTS

Studies to explore the utilization of FluoSolids for the beneficiation of low grade iron ore are now being conducted. In this operation, hematite is given a reducing roast to convert it to magnetite for subsequent concentration by wet magnetic means. Higher unit recovery of iron and the production of better concentrate grades indicates improved economics as compared with other beneficiation methods.

Among the other numerous fields currently under investigation are the calcination of alumina, the reburning of precipitated lime sludge and the self roasting of low grade sulfur ores.

If you would like more information on FluoSolids — the most significant advance in roasting technique in the last 30 years — write The Dorr Company, Stamford, Conn. or in Canada, The Dorr Company, 26 St. Clair Avenue East, Toronto 5.

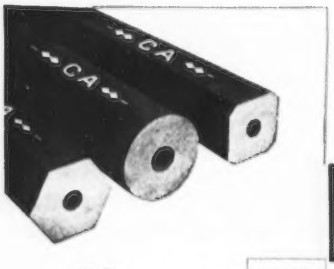
FluoSolids is a trademark of The Dorr Company, Reg. U. S. Pat. Off.

they're using
CRUCIBLE HOLLOW DRILL RODS
on the Delaware Aqueduct

CRUCIBLE HOLLOW DRILL RODS are helping construction crews to complete the vast network of dams and tunnels being built to increase New York City's water supply. When finished, water from the Pepacton, Neversink and Rondout Reservoirs, which will be impounded by a trio of earth-fill dams, will be conducted to New York through the 85-mile-long Delaware Aqueduct.

In rock drilling operations for the dams, effluent chambers and connecting tunnels, Crucible Hollow Drill Rods have proved their ability to outperform other types . . . to withstand the severest punishment with minimum breakage and bit loss.

That's because Crucible Hollow Drill Rods are made to tool steel specifications by the nation's leading producer of tool and other special purpose steels. These high quality drill rods have greater fatigue strength – you can count on lower cost per foot of hole in hard rock drilling. Next time you have a drilling job, be sure you order Crucible Hollow Drill Rods.



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FEATURE

Giant Trailer Hauls Texas Iron Ore

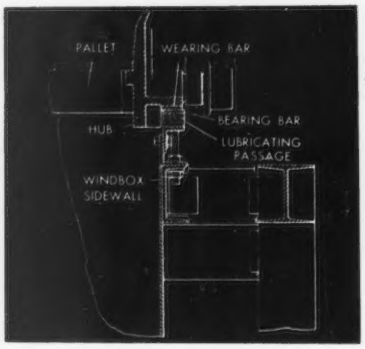
A 60% REDUCTION in haulage costs is what the huge San Angelo Ore Trailer has meant to the Lone Star Steel Co. Carrying 140,000 lb. of ore per trip from the company's open-pit mines to the beneficiation plant 4½ miles away at Daingerfield, Tex., the monster makes 10 trips a shift to haul a total of 625 long tons of iron ore.

Built with arc-welded steel plate for rugged duty, the ore trailer is mounted on an off-highway type tandem tractor and is said to have comparable maneuverability of a standard highway truck and trailer.

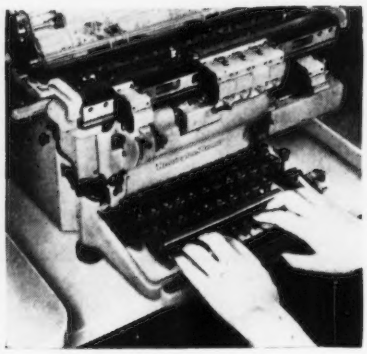
Lone Star Steel purchased the ore trailer in February of this year after turning the haulage problem over to Schonrock Equipment Mfg. Co., San Angelo, Tex. After studying the problem, Schonrock Engineers came up with the San Angelo ore trailer. After field tests it was placed in service and only minor changes have been necessary to fit it into the production cycle. Success of the venture has led to the Schonrock Cable-Dump Special Off-Highway Ore Carrying Trailer being adapted by the company as a new product with modifications to suit various individual requirements of potential users.

For further information, circle No. 1 on the Business Reply Card opposite page 118 and mail postage-free. (1)

TIRE made from anti-freeze adipic acid, and an ammonia derivative, offers from 2 to 5 times greater wear resistance than best tread rubber, according to Goodyear Tire & Rubber Co. (2)

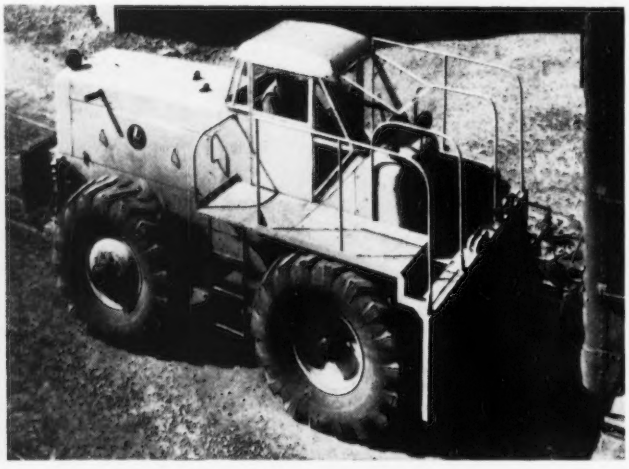


WINDBOX SEAL for sintering machines means better combustion, faster operation, less air, says Sintering Machinery Corp., Netcong, N. J. Seal is outside windbox to avoid fines, hot gases. (3)

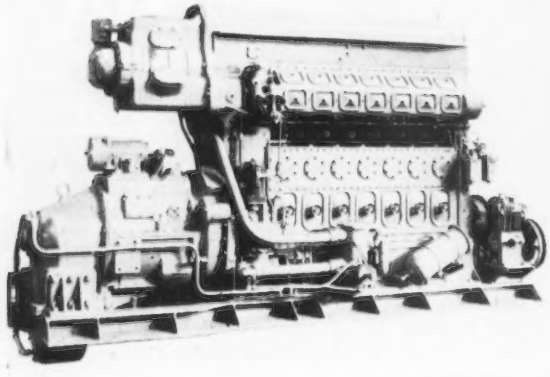


BOOKKEEPING MACHINE gives multiple records with mechanical proof of entry, instant account balances, automatically accumulated accounting control figures. Remington Rand, Inc. (1)

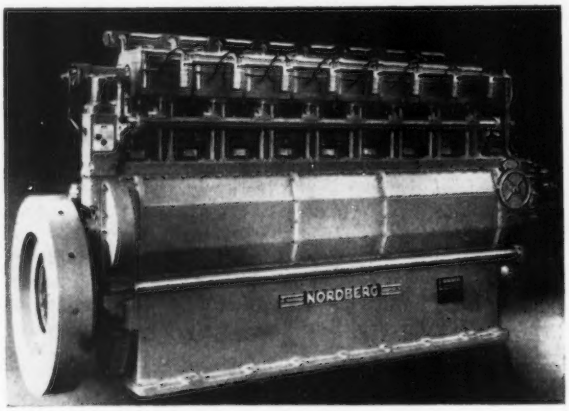
HOPPER OPENER is special gas-electric truck with built-in power-driven wrench that does job of several 2-man crews opening and closing gates in hopper cars. Elwell-Parker Electric Co. (5)



TORQUE CONVERTERS have helped add spotting box cars to versatility of wheeled tractors like this Hough Payloader, by providing easy, peak-load power and high torque required to move cars from standstill. Fuller Mfg. Co. (6)



DIESEL ENGINE, for stationary plants in 225 to 750-hp. range, using opposed pistons, is said to be a fraction of size and weight of conventional engines. (225-hp. unit weighs 7,100 lb.) Fairbanks, Morse & Co., Chicago, Ill. (7)



GAS ENGINES, types FSE-9 and FSE-13 are built to economically burn natural gas, propane, butane, and sewage gas. Various supercharged and non-supercharged types cover a range of 265 to 4,260 hp. Nordberg Mfg. Co. (8)

Why "breathing space" between each wire?

- To provide maximum flexibility—tiny, precise amounts of "breathing space" are engineered between each of these wires.
- There are 295 wires in this particular construction . . . 9 different sizes of wire.
- All wires are drawn in Macwhyte's plant to assure uniform quality.
- Heavy, tenacious lubricants fill the spaces between wires. This *Internal Lubrication* guards against corrosion and friction, and also increases flexibility.
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- From a thousand and one wire ropes, Macwhyte engineers are ready to recommend the right rope for your particular needs. For best, lowest cost wire rope service, write today for recommendations of the best constructions of rope to use on all your equipment.

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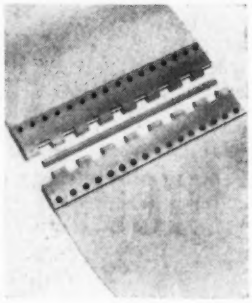
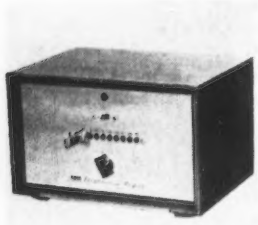
Ask for G-15 Wire Rope Handbook

Macwhyte Company, *2937 Fourteenth Avenue, Kenosha, Wis. Manufacturers of Internally Lubricated PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal, Stainless Steel Wire Rope and Wire Rope Assemblies. Mill depots: New York • Pittsburgh • Chicago • St. Paul • Fort Worth • Portland • Seattle • San Francisco • Los Angeles • Distributors throughout U.S.A.*

VOLT-AMP TESTER, Amprobe Junior, is a pocket-sized instrument designed to do complete testing. The snap-around unit measures current instantly without shutdowns or ammeter connections. As a voltage meter, it gives accurate readings on a full-size 1.8-in. scale. Pyramid Instrument Corp., Lynbrook, N. Y. **(9)**

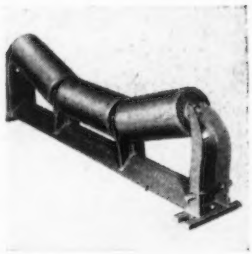
BELT SPLICER for trough-type belts is available in any desired width and will fit all of the various sizes of trough-type rollers. Easily installed by one man, the splicer features ease of uncoupling for machinery overhaul and is said to provide longer life for belts. Manufactured by Tennefos Mfg. Co., Moorhead, Minn. **(10)**





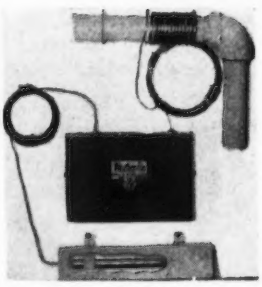
PORTABLE PAGING UNIT, for selective paging of personnel, can be plugged into AC power outlets to receive coded signals without special wiring. Audible and visible signals are received regardless of noise level or distance from stationary signals. International Business Machines Corp., New York. **(11)**

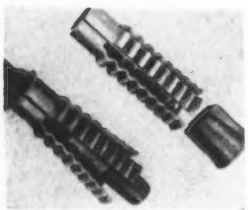
BELT CONVEYOR CARRIER series is designed with spun end rolls and welded steel frame. Seamless steel tube houses tapered roller bearing and is bored for precision alignment. Rolls can be lifted from frame without tools. Roller parts are interchangeable. Stephens-Adamson Mfg. Co., Aurora, Ill. **(12)**



ELECTRIC SPRAY GUN is suitable for a wide range of industrial uses, including painting, refinishing, touch-up work, rustproofing, stenciling, marking. Delivers over 90 lb. of pressure at 7,200 strokes per minute. No compressor is needed, just plug into AC outlet and use. Waldorf Sales Co., Yonkers, N. Y. **(13)**

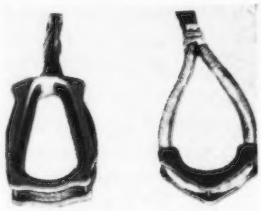
HEAT CONTROLLER, the Weather-Flo, is an indoor-outdoor regulator. Outdoor thermostatic bulb measures weather conditions and resets a "system" thermostat that regulates indoor temperature. Flexible copper tubing arrangement eliminates draining of system. Automatic Devices Co., Inc., Western Springs, Ill. **(14)**





STEEL ANCHOR expansion type for roof bolting has work hardened ribbing, which increases in depth from top to bottom, providing tightness in drilled holes of varying diameter. Equipment Corp. of America, Cleveland, Ohio. **(15)**

BRAIDED SLING features new type of reuseable thimble fitting attached by pins instead of conventional hammered-down clamps. Since fittings often outlast sling itself, reuse results in savings. A. Leschen & Sons Rope Co., St. Louis, Mo. **(16)**

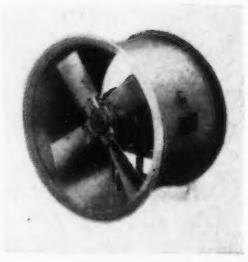


35-TON HYDRAULIC JACK has patented automatic air vent which eliminates 90% of "air lock" difficulty, weighs only 55 lb. which is 25% lighter than other types with same capacity. Duff-Norton Mfg. Co., Pittsburgh, Pa. **(17)**

PORTABLE LAMPS, fluorescent inspection units available with or without magnification, provide a cool, glare-free light source for use wherever close viewing is necessary. Stocker & Yale, Inc., Marblehead, Mass. **(18)**

AIR REGULATOR, capable of handling a large volume of compressed air with a minimum of pressure drop, has a capacity of 80 cfm at 100 lb. of line pressure. Two models vary only in inlet and outlet connection arrangements. Unit is 3-in. wide and 4½-in. high. DeVilbiss Co., Toledo, Ohio. **(19)**

FAN, a power line, direct-drive duct model, is built into a steel drum with rear and front mounted flanges. Motors are totally enclosed; blades are non-overloading, made of cast aluminum. For use in temperatures up to 110 deg. F., higher on special order. Chelsea Fan & Blower Co., Inc., Plainfield, N.J. **(20)**



CUT PLANT COST AS MUCH AS 1/3

WITH

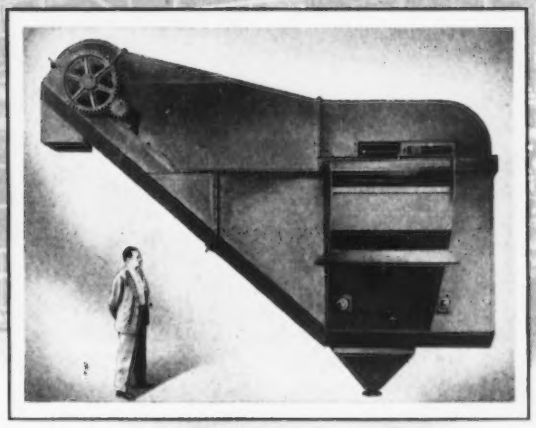
The WILMOT HEAVY DENSITY SYSTEM

The new Wilmot Heavy-Density unit requires 50% less floor space. This sharp increase in efficiency is obviously making possible substantial economies in construction costs -- in some cases as much as one-third. The unequalled compactness of the Wilmot unit results from its complete-in-one-unit construction and its unusual simplicity. It contains 5 less major parts and requires 4 less motors.

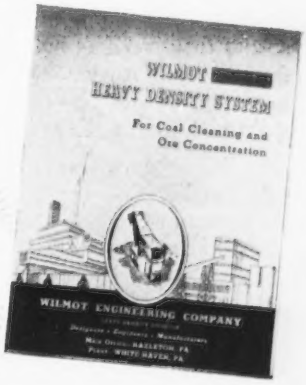
To these real reductions in capital cost, add the direct saving that results from the fact that the Wilmot Heavy-Density unit is custom-designed to your requirements and local conditions. You are not forced to adapt your plant to a "package" unit.

FEATURES INCREASED YIELD AND PRODUCT CONTROL

By clearing the two common heavy-media problems of maintaining accurate bath density and loss of coal to refuse, the new Wilmot system effects increased yield and better product control. Let us send you Bulletin 521 describing the complete technical details of how this new system cuts both plant construction and operating costs for metal and coal producers. Write for information concerning specific applications.



Above, size 150-A Wilmot Heavy-Density unit; feed capacity, 150 tons per hour. Also available in sizes for finished product capacities of 50 to 800 tons per hour. All are custom-designed; and of the complete-in-one-unit construction shown above, requiring 50% less floor space.



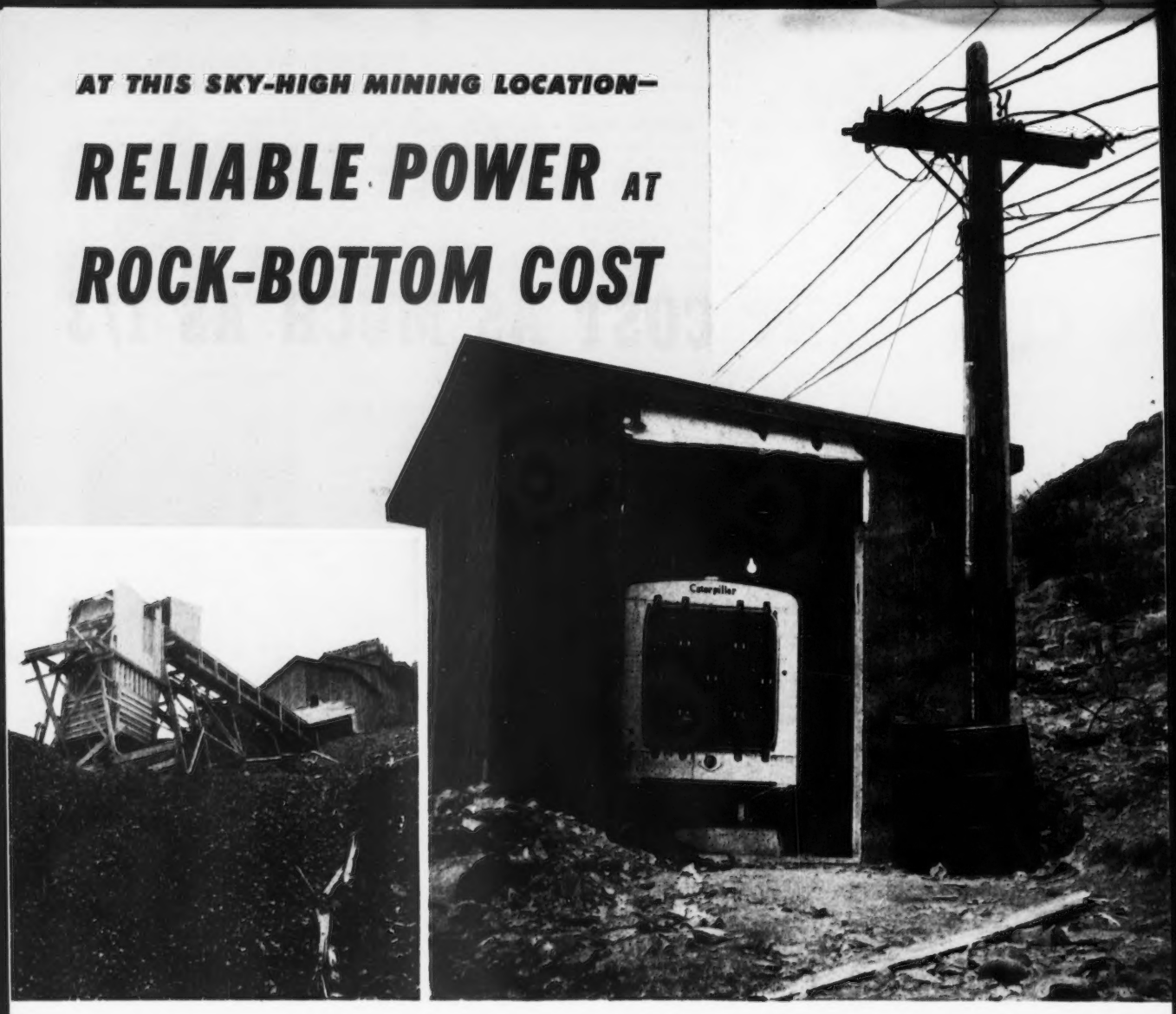
Send for
BULLETIN 521
on this New Development in Heavy Media

WILMOT

WILMOT ENGINEERING CO.
HAZLETON, PA.
Plant: WHITE HAVEN, PA.
HEAVY DENSITY DIVISION

AT THIS SKY-HIGH MINING LOCATION—

RELIABLE POWER AT ROCK-BOTTOM COST



NINE thousand feet up in the Rockies, and 30 miles from the nearest town, is this small but highly efficient gold mine. Owned by the Crystal Hill Mining Co. of Center, Colo., it produces 100 tons of ore a day.

Reliable, economical power is a "must"—and that's why you find all-Caterpillar power here. A Caterpillar D13000 Diesel Engine *with 34,000 hours on the meter*, and a D17000 Electric Set—a "youngster" of 1,000 hours—furnish power for the mill and mine. "I bought the Cat* Electric Set," says owner John Hamm, "because of local service facilities, and because I've had such good results with other Caterpillar Engines in six years of high-altitude gold operation."

Fast service from a well-stocked Caterpillar Dealer is important in a remote mining location. When you standardize on Caterpillar power, you eliminate your parts inventory, increase operator efficiency, and have one-stop dealer service.

Caterpillar Diesels are built to deliver full power, year after year. They will not foul, even when idling, on low-cost No. 2 furnace oil. This cuts costs three ways: reduced engine maintenance, cheaper fuel, less of it.

Caterpillar horsepower ratings are factual and honest. There is a complete line of 12 Cat Diesels up to 500 HP, and Electric Sets up to 315 KW. Your dealer will show you the model that will do most for you at lowest cost.

Caterpillar Tractor Co., Peoria, Illinois.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

WE'VE MADE CLAIMS... NOW MAKE US PROVE THEM

Equipment Shorts

AUTOMATIC CONTROL. An electric contact controller for solenoid valves, warning signals and motors has just been announced by the H. O. Trerice Co., Detroit, Mich. Vapor actuated, the controller is designed to stand a fairly heavy electrical load. Unique feature of the controller is a red and green pilot light to show at a glance the position of the switch. Standard controllers operate on 115 vac. When specified, controllers can be furnished for currents up to 250 vac or dc. (40)

FLOW TEST KIT. A portable wide-range flow test kit for laboratory research and field flow checking work consists of five Pyrex brand glass Tri-Flat metering tubes with five spherical constant-density floats and instruction handbook, all contained in a convenient carrying case. The handbook included with the kit contains a compilation of performance data for the new Tri-Flat metering elements. Performance is predictable with high accuracy and the check calibrations formerly required for low flow rate work are now eliminated. Fisher & Porter Co., Hatboro, Pa. (41)

ASBESTOS - NEOPRENE GASKET. A gasket material, Asbestoprene, has been developed from asbestos and the Du Pont Co.'s synthetic rubber, neoprene. Asbestoprene, made by Victor Mfg. and Gasket Co., Chicago, Ill., is unusual in that it combines compressibility with heat resistance. In these two properties, Victor engineers say the new material fills a gap in their line of gasketing materials between compressed asbestos sheet and cork or rubber. (42)

SOLDER. A rosin core solder, active yet non-corrosive, has recently been developed by Federated Metals Div., American Smelting and Refining Co., New York, N. Y. Known as RTS 200, tests are reported to show that its spread is 30% greater than that of conventional rosin core solders. Oxide films and corrosion products on the parts being soldered need not slow down operations, because this solder pierces such retarding agents four times faster than ordinary solders. Despite the exceptional activity of the RTS 200 flux at soldering temperature, there is no harmful corrosion residue when tested under the high humidity conditions. (43)

LIQUID LEVEL CONTROL. Based on the capacitive action of liquid surrounding a porcelain-enamel covered electrode, the Belmont level control provides adjustment of liquid level and cut-in, cut-out differential over very wide limits. In operation, the unit consists of the probe mounted directly at the location of the controlled liquid; a connecting cable which can be 1,000 ft. long if necessary; and the control unit which can thus be located for operating convenience. The two main controls (liquid level and differential) are designed for screwdriver adjustment while a vernier or fine control on liquid level is operated by a panel-front knob. Standard models operate from 115-volt 60 cycle supply. Thermo Instruments Co., Belmont, Calif. (44)

WELDING ELECTRODE. An electrode marketed under the name "Stoody Build-Up," by Stoody Co., Whittier, Calif., has been developed with the sole idea of providing the exact properties necessary in a material used for rebuilding carbon steel and alloy steel parts—sound deposits, high tensile strength, toughness and resistance to cold flowing. As an underbase it is generally recommended for such parts as drive sprockets, churn drills, shovel drive tumblers and house rolls, tractor rollers and idlers, tool joint shoulders and clutch jaws. (45)

ELECTRIC MOTORS. Fractional horsepower Varidrive motors in combination with right-angle Syncrogears are now available through a new development of U. S. Electrical Motors, Inc., Los Angeles, Calif. Designed for application requiring low, variable speeds with a compact, right-angle hook-up, this Varidrive-Syncrogear motor, called type VA-GW, is offered in ¼, ⅓, ½ and ¾ hp. with speed variations up to 10:1. (46)

AIR SAMPLER. This unit was developed in the laboratories of the New York office of the United States Atomic Energy Commission and manufactured in large quantities for them by Staplex Co., Brooklyn, N. Y. Through permission from the Commission, the company now makes available these high volume air sample units for general use. The prime purpose of these units is for sampling large volumes of air for particulate matters by means of a filter paper. The sampler has been used successfully to sample air containing particles one hundredth of a micron in diameter. The unit employs a turbine type blower. The present designs permit the use of a filter paper approximately 4 in. in diameter. (47)

WINCH-HOIST. Lug-All winch-hoist handles up to 1½ tons in any direction, yet weighs only 8¾ lb. A big help is the unique built-in pulley block which permits work around corners and as close as 10 in. These hoists are now available in ¾, 1⅛ and 1½-ton sizes. In addition, a number of most useful accessories are available at low cost which greatly increase usefulness. Lug-All Co., Wynnewood, Pa. (48)

USE THIS CONVENIENT CARD

to obtain further information on products and bulletins mentioned in the New Products Digest. Circle item numbers, tear out and mail.

Not good after November 1, 1953, if mailed in the U.S. or Canada.

Engineering and Mining Journal—September, 1953

NOT GOOD AFTER NOVEMBER 1, 1953—if mailed in U. S. or Canada

Please send me the catalogs or further information about the items from New Products Digest whose numbers are circled.

1	8	15	22	29	36	43	50	57	64	71	78	85	92
2	9	16	23	30	37	44	51	58	65	72	79	86	93
3	10	17	24	31	38	45	52	59	66	73	80	87	94
4	11	18	25	32	39	46	53	60	67	74	81	88	95
5	12	19	26	33	40	47	54	61	68	75	82	89	96
6	13	20	27	34	41	48	55	62	69	76	83	90	97
7	14	21	28	35	42	49	56	63	70	77	84	91	98

My Name ..... Position .....

Company .....

Address .....

For Your Files

This informative manufacturers' literature is free unless otherwise specified. To obtain bulletins circle their numbers on card below and mail.

MATERIALS HANDLING. A new 8-page "Transporter" bulletin, No. 4501, published by Yoemans Brothers Co., Melrose Park, Ill. includes problem-solution-result reports covering foundry, meat packing, tannery and municipal waste handling installations. In each case, the materials handled are comparable to those found in other industries. (67)

SKILL IMPROVEMENT. A revised edition of "Your Skill Improvement Program" has been issued by the U. S. Department of Labor's Bureau of Apprenticeship. This 16-page booklet, designed to help the employer develop a skill improvement program, contains a check list for the employer's use in making spot evaluations of his current training system and training needs. It also outlines services of the Bureau which are available to the employer in establishing training programs to meet those needs. (68)

FRONT END LOADER. Two-color folder describing the construction and industrial uses of the Baker-Lull Shoveloader has been issued by Baker-Lull Manufacturing Co., Minneapolis, Minn. The literature illustrates applications and attachments for the front end loader, lists specifications of the equipment and describes performance characteristics. (69)

ELECTRIC MOTORS. Louis Allis Co., Milwaukee, Wisc. has prepared bulletin No. 1300 on its line of wound rotor motors, ½ to 1,000 hp., covering wound rotor principles of operation and performance curves and characteristics that show how these units are suited to particular jobs in industry. It also outlines the construction, methods of manufacture, and the various enclosures available. (70)

DIESEL ENGINES. Bulletin S-500-B55, entitled "New Developments in Oil Diesel, Dual Fuel Diesel and High Compression Spark Ignition Engines," by Volney M. Holmes, Assistant Manager, Engine Division, Worthington Corp., describes and illustrates up-to-date features of modern, economical, heavy duty, internal combustion engines. It includes a heat balance chart illustrating waste heat recoverable from exhaust gases and jacket cooling water, accompanied by fuel cost charts for determining most economical type of engine selection. (71)

LIQUID-LEVEL CONTROL. A single-thyratron electronic liquid-level control operating without radio frequency from a single capacitive type probe is described in Folder LL4-453. This publication illustrates the single unit control, the probe, and alternative schematic arrangements for installation. Absence of moving or contact-making parts is related to applications in the refrigeration, petroleum, chemical and food processing fields. Specifications are included. Thermo Instruments Co., Belmont, Calif. (72)

METERS & CONTROLS. Bulletin 18 is offering information on the complete line of meters, control equipment and engineering services by Bailey Meter Co., Cleveland, Ohio, is written for engineers in power plants, public utilities, and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, illustrations, and detailed literature references are included. (73)

CIRCUIT BREAKERS. Application of AB-1 circuit breakers to reduce downtime and maintenance is discussed in Booklet B-5654, available from the Westinghouse Electric Corp. Actual cases—with savings given—show how the replacement of fused devices by AB-1 circuit breakers results in improved continuity of operation. (74)

BITS. Nine new styles of carbide tipped mining tools are featured in a new mining tool catalog just released by Vascoloy-Ramet Corp., Waukegan, Ill. (75)

MAGNETS. Magnetic Engineering & Mfg. Co. announces catalog #752 describing and illustrating Memco High Power Suspended Magnets. The rectangular double gap suspended magnets are made in four types, medium, standard, heavy duty, and extra heavy duty in a range of sizes from 12" to 60" wide. Circular suspended magnets are recommended for those applications where the burden on the belt is very heavy at the center. (76)

AIR COMPRESSORS. Descriptive data and engineering specifications on the Cooper-Bessemer M-Line of compressors is presented in 44-page Bulletin M-70. Covers use of multi-stage, multi-cylinder units 100 to 5,000 hp. with discharge pressures up to 20,000 psi. Gives engineering particulars on latest automatic controls and recommended compressor installation for efficient, low cost operation on mining and processing work. (77)

GATES AND VALVES. Stephens-Adamson Mfg. Co. has just released Bulletin 1252 covering their complete line of gates and valves. Unusual units listed include the "Twistite" double closure bin valve and the Moore bin gate. Complete details and dimensions are also shown for slide gates, quadrant gates and other conventional units. (78)

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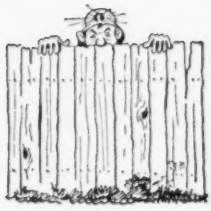
to obtain further information on products and bulletins mentioned in the New Products Digest. Circle item numbers, on reverse side, tear out and mail.

OVER 50 YEARS of gold panning progress was demonstrated recently in Englewood, Colo., on the bank of Dry Creek where gold was first discovered in Colorado in 1858. During the 50-year Jubilee a Denver Mechanical Gold Pan, manufactured by the Denver Equipment Co., was used to compare small, portable high-capacity modern methods with hand panning.



By-Products

GROWING

Westinghouse has nearly doubled its capacity for production of generators and large motors since 1950.

American Brake Shoe Co. is expanding its facilities for manufacture of powder metallurgy products.

Republic Steel Corp. will build a new plant in Toledo, Ohio, for production of 50,000 lb. per day of powdered iron. Republic is first of the major steel companies to start commercial production.

Caterpillar Tractor Co. will spend $45-million for a new plant and equipment for existing plants.

TAKING OVER

Westinghouse Air Brake Co. has purchased the earth moving and related business of R. G. LeTourneau, Inc., for approximately $19,500,000.

Joy Mfg. Co. has acquired Barnes and Reinecke, Inc., Chicago engineering firm, specializing in mechanical research and development.

Clark Equipment Co., maker of materials-handling industrial trucks, now owns all the capital stock of Ross Carrier Co., Benton Harbor, Mich.

H. K. Porter Company, Inc., Pittsburgh, has acquired a controlling interest in A. Leschen & Sons Rope Co., St. Louis, Mo.

Chicago Pneumatic Tool Co. has acquired the assets of Jacobs Mfg. Co. of West Hartford, Conn.

Oliver United Filters Inc. announces the acquisition for manufacture, sales and service of all rights in connection with the Centriclone, from the former owners, Equipment Engineers, Inc., San Francisco.

Minnesota Mining & Manufacturing Co. has announced a $7-million agreement by which Irvington Varnish & Insulation Co. becomes a division of 3M.

BY ANY OTHER NAME

Ludlow-Saylor Wire Cloth Co. is the new name to use in addressing the St. Louis firm known since 1875 as the Ludlow-Saylor Wire Co.

American Ventilating Hose Co., a division of Callahan Zinc-Lead Company, Inc., is changing its name to Flexaust Co.

Gunnison Homes, Inc., nationally-known housing subsidiary of United States Steel Corp., has changed its name to United States Steel Homes, Inc.

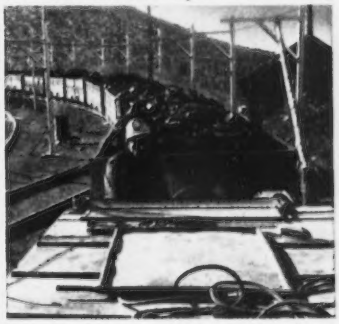
NEW POST

Smith Engineering Works, Milwaukee, Wisc., announces the appointment of Mr. Robert S. Bailey as representative for Southern California.

what's NEW in Engineering

Laboratory facilities for engineering research are available to individuals and groups with worthwhile projects at Richmond Engineering Field Station, administered by Department of Engineering, University of California. Charges are based on actual expenditures with appropriate overhead. For information, write Institute of Engineering Research, University of California, Berkeley.

Rebuilding a near-ghost mine at Sunnyside, Utah, for greater coking-coal production with higher efficiency, is a current major project of Kaiser Engineers. The original Sunnyside mines, opened in 1896, were in bad condition. The problem was to rehabilitate and expand two existing

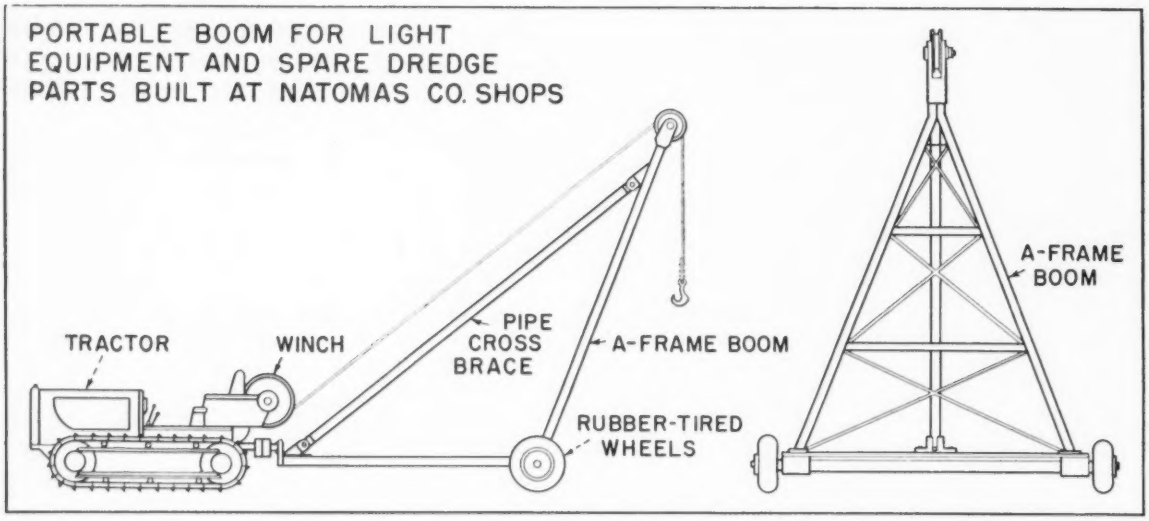


mines and open a third to raise coking-coal production from 1,000,000 to 1,715,000 tons per year. We'll send you a reprint of an article by Wesley Hyatt and R. G. Heers in *Coal Age* which tells the full story of Sunnyside's emergence from a "near-ghost" to one of the most efficient and modern coal producers in the West.

A $50,000 bonus goes to the first person to bring in a Tennessee oil well that will produce 50 barrels a day for six months, according to a new state law. Only 35 wells are now producing in Tennessee, but geologists think the State has rich oil possibilities.

When it comes to research, preliminary engineering studies, engineering design and layout, estimating, preparation of specifications, construction programing, negotiation of contracts, and procurement and expediting of materials and equipment—call or write: Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

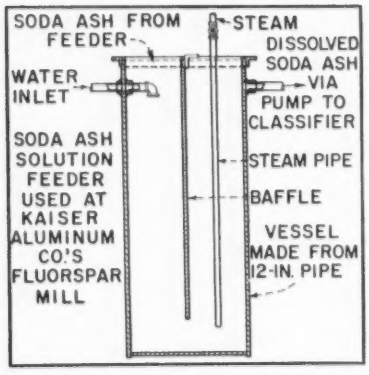
OPERATING IDEAS



Portable Hoisting Boom Handles Dredge Parts

THE HANDY AND VERSATILE portable boom shown above is used to great advantage by Natomas Co. at its Greenan Placer property near Copper Canyon, Nevada, for loading and unloading light equipment and spare dredge parts from trucks in the storage yard and repair shops and for lowering them on a scow in the dredge pond for transfer to the dredge hull. The boom structure of the unit is is of A-frame design and made from steel pipe, with the triangular chassis resting on two wheels. The complete assembly is coupled direct to a tractor unit equipped with a winch. Tractor operators control hoisting from the driver's seat. The winch is mounted conveniently behind the seat.

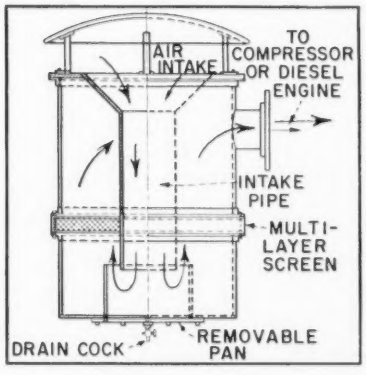
Feeding Soda Ash In Solution Cuts Consumption 50%


SODA ASH FROM FEEDER
STEAM
DISSOLVED SODA ASH VIA PUMP TO CLASSIFIER
WATER INLET
SODA ASH SOLUTION FEEDER USED AT KAISER ALUMINUM CO.'S FLUORSPAR MILL
STEAM PIPE
BAFFLE
VESSEL MADE FROM 12-IN. PIPE

WALTER B. JOHNSON, mill superintendent directing operations at Kaiser Aluminum Company's new fluorspar mill at Fallon, Nev., reports that feeding soda ash in solution instead of in the conventional ground form to the grinding circuit ahead of flotation has cut consumption of this reagent some 50%. The soda ash is dissolved in the simple steel vessel shown. It consists of a long cylinder made from 12-in. pipe containing a steel baffle in the center, a water inlet at one side near the top, and a solution outlet on the other side. Steam for heating the inflowng water is introduced by a small pipe terminating near the bottom of the cylinder, and soda ash by a mechanical feeder. The solution outlet is connected to a small pump which directs the soda ash solution to the classifier operating in closed circuit with a ball mill.

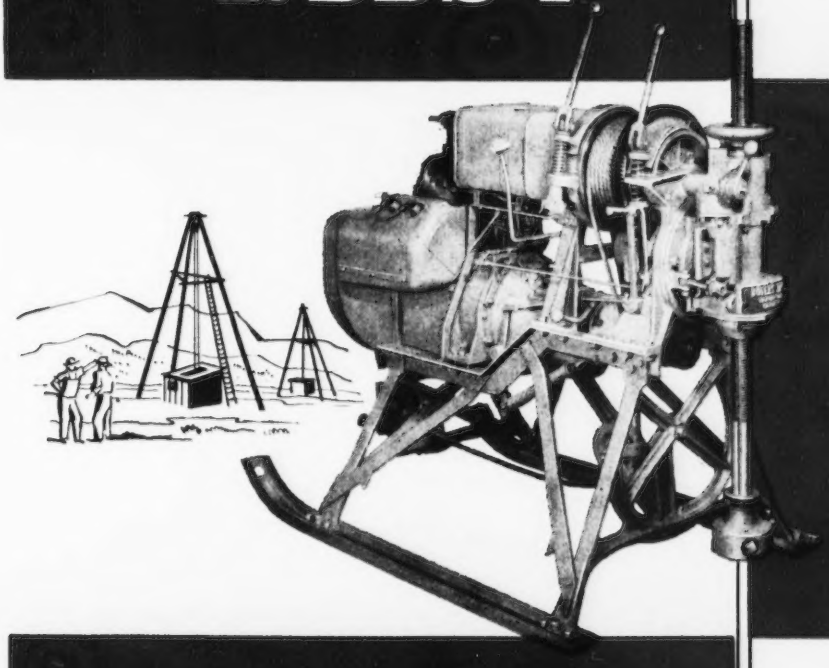
An Efficient Air Filter

THE SIMPLE AND EASY air filter (right) has given good service at several western mines when used on compressor and diesel engine air intake lines. It can be made at relatively low cost at the mine machine shop, and as designed both the screen unit and the pan just below the air intake pipe can be removed for cleaning without detaching the filter body from the main air line. This is done in a matter of minutes by removing the bottom part of the filter body, or by just taking out the pan if this unit alone requires cleaning. Water collected in the pan can be drained by simply opening the drain cock at the bottom of the removable pan.



you're looking at the most USEFUL surface diamond drill you can buy

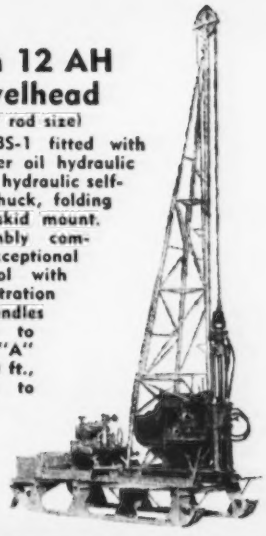
the BBS·1



• with 12 AH swivelhead

("B" rod size)

Here is BBS-1 fitted with twin cylinder oil hydraulic swivelhead, hydraulic self-centering chuck, folding mast and skid mount. This assembly combines exceptional feed control with high penetration speed. Handles "B" rods to 650 ft., "A" rods to 900 ft., "E" rods to 1200 ft.



• with 1-JEG swivelhead

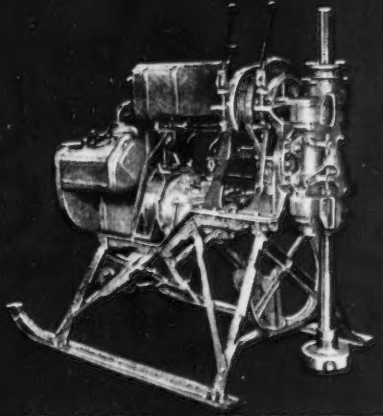
("E" rod size)

This heavy duty gear feed swivelhead incorporates an instant shift mechanism to any of four feeds, regardless of speed or bit pressure. Handles "E" rods to 1200 feet. This head is interchangeable with our JV model.

• with 12 AG swivelhead

("A" rod size)

Equipped with this four feed gear swivelhead, BBS-1 handles "A" rods to 900 ft., "E" rods to 1200 ft. — gives heavy drill performance at minimum weight and cost. All BBS-1 combinations available with 24 or 30 h.p. Wisconsin gasoline or 32 h.p. diesel engine.



• also BBS-1 Jr.

All swivelheads illustrated are available on lighter BBS-1 Jr. model with 12 h.p. gasoline or 15 h.p. diesel engine. Capacities: "E".....600 ft. "A".....400 ft. "B".....300 ft.

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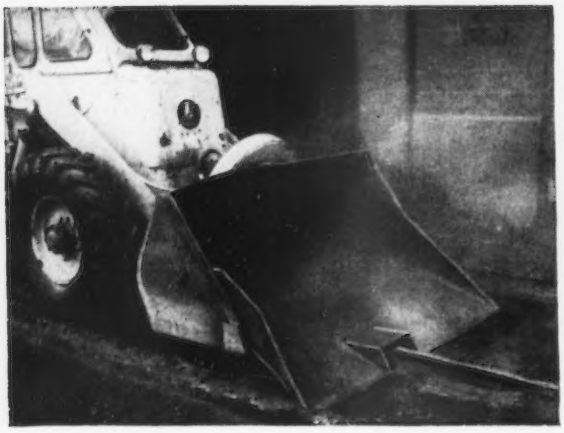
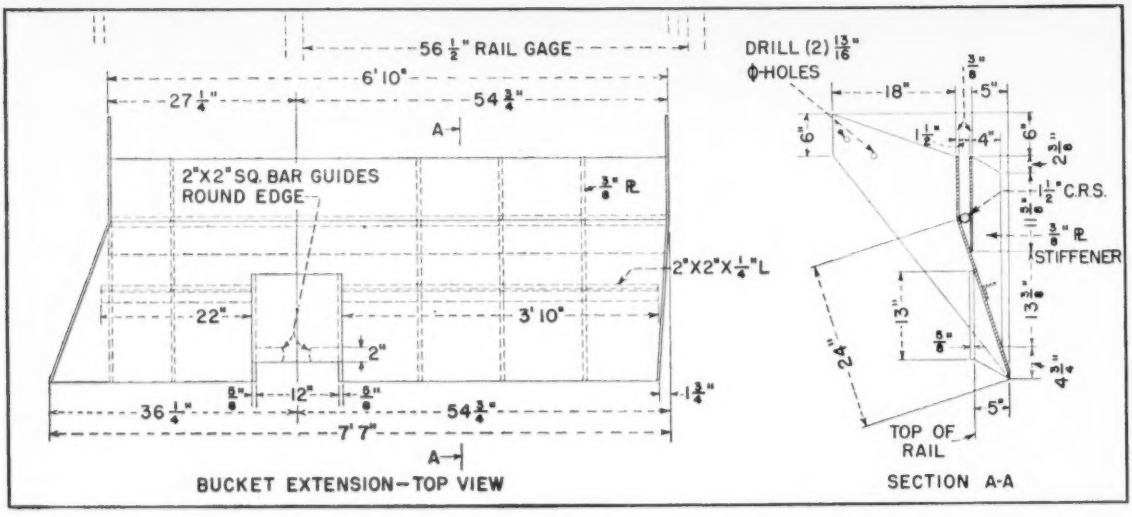
VANCOUVER, CANADA



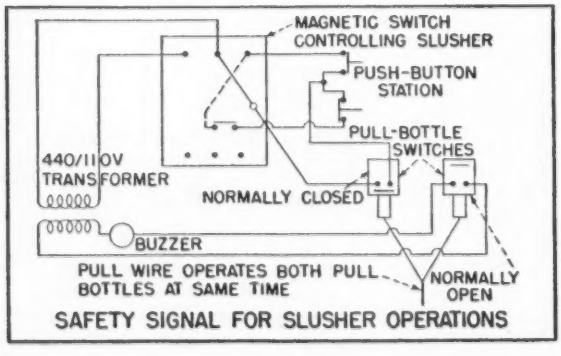


Front-End Loader Converted to Track Cleaner

COST-CONSCIOUS mine operators have often asked us, "What can be done to save labor required for track cleaning?"—and here's one answer, submitted by Robert I. Kingman, sinter plant superintendent, National Lead Co., MacIntyre Development, Tahawus, N.Y. The unit shown is a bucket extension for the Hough 1½-cu. yd. Payloader which was designed for the removal of spill from railroad cars during loading of sinter.

The extension is readily attached to the Payloader bucket with four bolts. It is designed to clean up between standard-gage rails readily with sufficient clearance above the ties. With this bucket extension, time required to clean the car spray basin under the sinter loading chutes was cut by 30 hours per week.

(Editors note: In a similar way, the remodeled loading bucket of an Eimco loader was used to clean track in a western mine.)



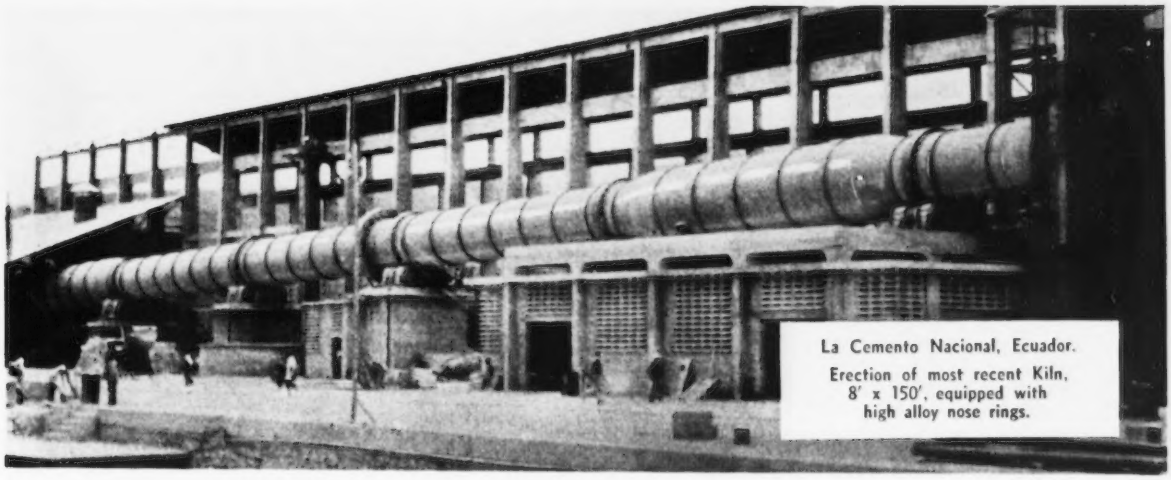
Two Ideas for Slusher Operators

DICK MAY, mine electrical supplier and consultant, Wallace, Idaho, sends in these two practical items for slusher operators.

1. Ammeter on Slushers. Many times the operator cannot see the slusher bucket until it has been pulled to the chute, and then he finds that he has scooped up too small a load. If an easily-read ammeter is mounted in front of him which registers the load on the slusher, he can tell at a glance whether he has

(*Continued on p. 124*)

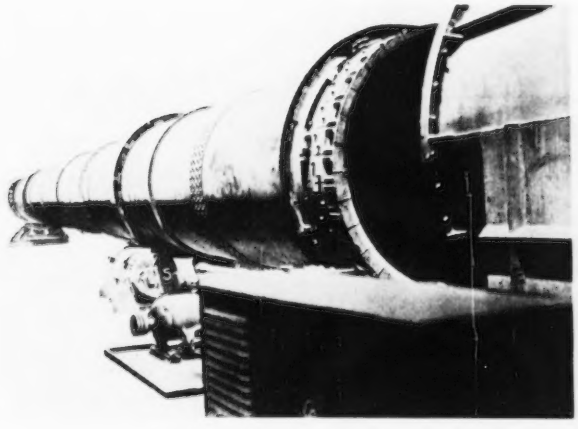
FOR TOP PERFORMANCE..



La Cemento Nacional, Ecuador.
Erection of most recent Kiln, 8' x 150', equipped with high alloy nose rings.

KENNEDY Machinery and Equipment

LEADS THE FIELD!



9' x 11' x 350'
Rotary Kiln
—Wet Process.

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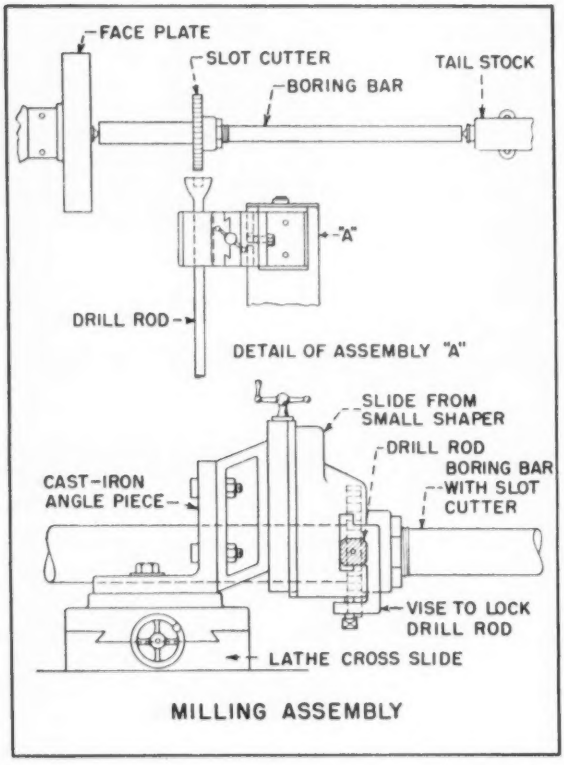
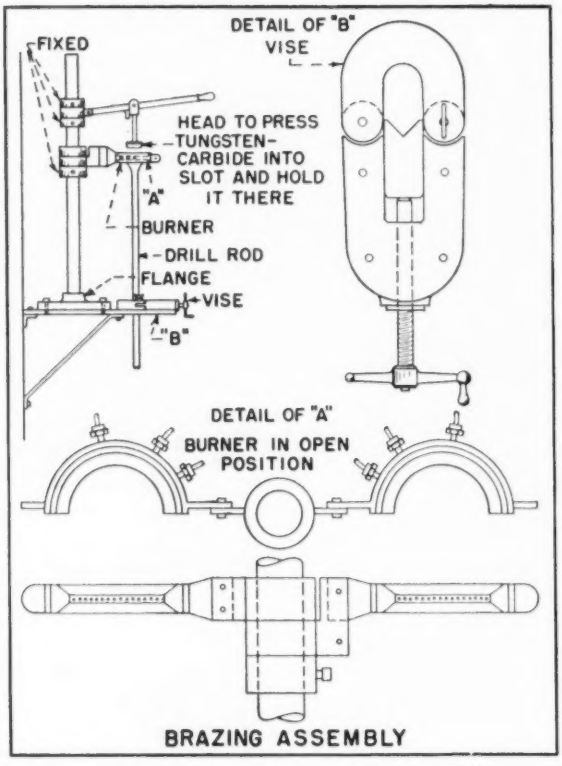
a full load or not. This should also prevent a few burnt-out slusher motors.

2. Safety Cord for Slushers. Oftentimes an electric slusher is operated in an area which must be crossed by timber men, supply crews or repair crews. If the operator is out of sight, these crews must notify the operator to stop the slusher. This can be done by installing a double pull-bottle switch as shown schematically. If a workman wishes to stop the slusher, he pulls on the wire and holds it. The slusher cannot operate until the wire is released. If the workman wishes to signal the slusher operator, he pulls the wire which stops the slusher, and then signals the operator by pulling the same wire further. This set-up has performed safely and effectively where tried.





Shop Expert Tells How To Attach Tungsten–Carbide Inserts

JOE GLENNON, master mechanic at Idaho Maryland Mines Corp., Grass Valley, Calif., describes the following system of attaching chisel-type tungsten-carbide inserts to steel. Three steps are involved—(1) forging the bit body at one end of the steel, (2) milling the slot to receive the tungsten-carbide insert, and (3) brazing the insert into the slot. Step 1 is a conventional forging process. Step 2 usually requires a milling machine, but lacking one, Mr. Glennon performs the milling operation in a lathe as shown. A boring bar is fitted with a standard plane milling cutter. A simple device is bolted onto the cross-slide of the lathe to hold and move the drill rod during milling operations. This device consists of a cast-iron angle piece, spacer, and slide from a small shaper.

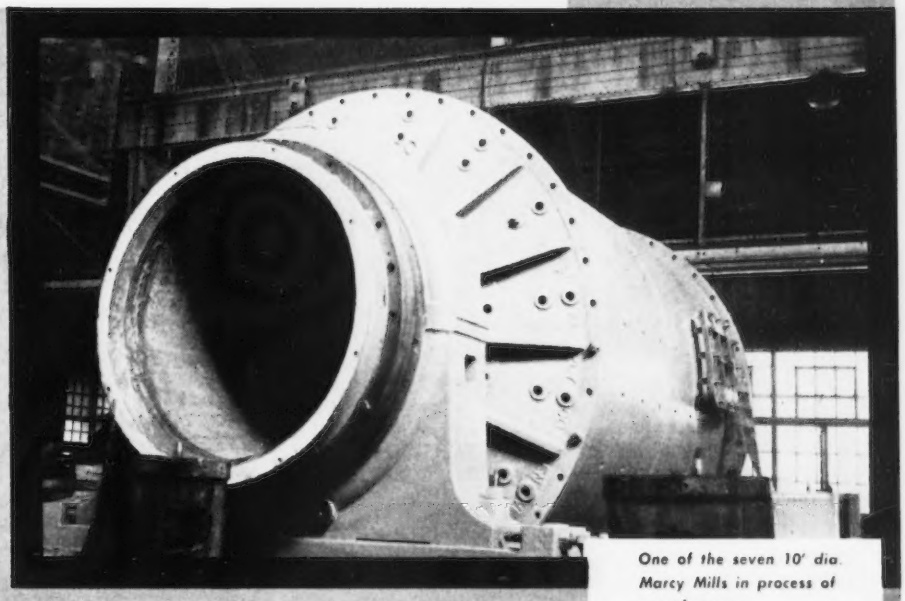
The brazing or soldering operation (Step 3) is performed with the unique assembly shown. This consists of a vertical round steel column with flange bolted to a steel table top equipped with a hinged circular acetylene burner, and a lever-operated head or ram to press in and hold the tungsten-carbide insert during brazing operations. An adjustable vise on the table top holds the drill rod.

Are You Sinking A Shaft?

IF SO, here are a few ideas published under Operating Ideas which you might like to consult in your back issues of E&MJ:

Concrete Shaft Members, Sept., 1952, p. 130; Lightweight Forms for Shaft Concreting, June, 1952, p. 110; Shaft Guide for Easy Alignment, Jan., 1951, p. 93; Pneumatic Guides for Skips, April, 1946, p. 106; Rubber-Tired Wheels for Cages, Dec., 1950, p. 112; New Bottom-Dump Skip, Dec., 1949, p. 96; Self-Dumping Skip, May, 1947, p. 89; Hinged Safety Skip for Shaft, Sept. 1951, p. 108; Guillotine Gate for Loading Skips, June, 1951, p. 107; Mucking Pan for Shafts, Dec., 1946, p. 73; Scraper Ramp for Incline Shaft, Feb., 1951, p. 128; Safety Cable for Skips, June, 1950, p. 93; Safety Device for Man Truck, March, 1947, p. 90; Sinking Bucket with Hinged Guide Shoes, Feb., 1949, p. 128; Inter-Com Unit for Shaft Sinking, Feb., 1950, p. 148; Chain Chairs for Shafts, Oct., 1946, p. 87; Triple King Bolt for Skips, March, 1947, p. 92; Air-Operated Doors Protect Shaft, Jan., 1953, p. 112; Mine Elevator, Oct., 1952, p. 112.

MARCY MILL PERFORMANCE PROVED ON *TACONITE*, TOO!



One of the seven 10′ dia. Marcy Mills in process of manufacture.

8 MARCYS OPERATING ON THE IRON RANGE

The advantages of the Marcy principle of grinding—low pulp line and rapid circulation of mill content, through use of a grate discharge—have been proved by the wide acceptance with successful mining companies throughout the world.

On the Iron Range, for example, there are 8 Marcys—1, 9′x12′ rod mill; 1, 10′x10′ ball mill; 3, 10′x12′ rod mills; 3, 10′x14′ ball mills.

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OR CALL,

NOW.

VIOLA MACMILLAN, outstanding Canadian mining personality, and president of the Prospectors & Developers Assn. for the past nine years.

DYNAMIC LEADER, Mrs. MacMillan is seen here with (l. to r.): P. T. Kelly, Ontario's Minister of Mines; George Prudham, Minister of Mines & Technical Surveys, Ottawa; D. D. Patterson, Provincial Treasurer of New Brunswick; Dr. Duncan Derry, president, Geological Assoc.

E & M J Salute to Viola

NINE YEARS AGO, not without misgivings in some quarters, the Prospectors and Developers Association of Canada elected a woman as its president.

There were many who doubted the wisdom of this novel step; some who prophesied dire things for the organization; a few who predicted that the new president wouldn't last the year. "Prospectors and mine developers are too masculine a lot to be led by a woman; the job would prove too rugged!"

Well, the prophets were wrong. The lady president not only survived her first year; she's still in office. Mrs. George MacMillan (known as Viola to a thousand friends all over the continent) has proved herself to be one of the ablest officers the Association has ever had the good fortune to elect.

In assessing the talents which have resulted in so many years of dynamic leadership we consider, of course, Viola's drive, her charm, her personality and her amazing "know-how"; and, equally important, her ability to overcome the handicap of being a woman. It *was* a handicap when Viola first took office, and she overcame it by insisting at all times that her colleagues forget about it, and meet her on equal terms. In debates and discussions she asks no favors—and gives none. Somehow she makes her associates forget entirely that they are dealing with someone of the opposite sex.

How Viola does this may well puzzle you. See her at the head table of the annual dinner of the Association and you see a quietly dressed, petite, attractive woman. But when this little lady rises to her feet and reaches for the mike to expound her favorite topic—Canadian mining—there is a transformation. Here is a speaker who can lift a roomful of men from after-dinner apathy to enthusiastic attention. From whence comes her strength? Well—one of the older prospectors summed it up this way. "Sure our president's all woman. But she's just plain in love with mining. And you know how it goes with a woman in love—she gets carried away. Viola carries us all away with her."

That's one explanation. Another is that, petite and pretty as their president may appear, the members of the Association know she is as much at home in the big rough boots and jacket of the prospector and miner as she is in her formal gown. And she's as much at home in the bush or the mine as she is at the linen-covered dinner table. For Viola MacMillan is a prospector and mine developer in her own right; and she doesn't carry on business only from the charming living room of her home on Toronto's fashionable Oriole Parkway. Viola carries on business wherever she happens to be—about 16 hours a day—whether at home, in her office, or at one of her properties.

Born in Muskoka, Ontario, Viola MacMillan started her career as a secretary. But in 1930, seven years after her marriage to a handsome prospector — George MacMillan — she climbed into high boots and jacket and went prospecting herself. This move proved fortunate both for herself and the mining industry. Her personal success is reflected in the various companies she heads. Chief of these is Violamac Mines Ltd., British Colombia's lead-zinc producer. She is also interested in asbestos, copper and gold in northern Ontario, oil in Alberta, base metals in New Brunswick's new Bathurst area, and uranium in Saskatchewan. Uranium, by the way, is her newest enthusiasm. She's absolutely sure it's the big mineral of the future.

The widespread nature of her own interests is a reflection of Viola MacMillan's perspective of the whole Canadian mining industry. She has a "big" Canadian outlook which enables her to sell mining wherever she goes.

Association business is her business and today the Association's position is a tribute to its president's ability. It is stronger, more prosperous, more influential than ever before in its history. And the members are grateful to Viola, as is proven by the wail that goes up when she threatens to retire, which she does regularly, every year. It's most people's guess (and the members warmest hope) that no such move will come for a long time. On the contrary, after nine years of Viola's leadership, it is predicted in some quarters that she will continue as president of the Prospectors and Developers Association forever! It is certain that the Association will never find a more colorful and energetic leader.

4 FEATURES THAT MAKE STOODY 21 FIRST FOR ECONOMICAL WEAR PROTECTION!

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PERSONAL NEWS

AMERICAN MINING CONGRESS 1953 Metal Convention will be held in Seattle, Wash. September 21-24. The Program Committee, shown here, includes (left to right): John C. Fox, E. B. Douglas, L. J. Randall, P. E. Oscarson, Karl W. Jasper, R. D. Leisk, C. F. Holcomb, Roy B. Earling, Glenn Carrington, Joseph Daniels, E. C. Stephens, Norman E. Hanson, Julian D. Conover, P. R. Bradley, Jr., Robert M. Hardy, Joshua Green, L. A. Williams, J. C. Archibald, Jr., Frank Lilly, Kuno Doerr, D. A. Somerville, W. P. Morris, S. M. Strohecker, Jr., A. O. Bartell, Drury A. Pifer, William M. Yeaman, Frank N. Marr, Geo. H. Waterman.

V. P. GEFFINE, formerly senior vice president of the parent Cleveland-Cliffs Iron Co., has been elected president of Cliffs Power & Light Co.

C. W. ALLEN, recently elected vice president of Cleveland-Cliffs Iron Co., who will be in charge of mining, land and lumbering operations.

H. J. LEACH was recently appointed manager of Cleveland-Cliff's Minnesota mines, to take over the position formerly held by G. J. Holt.

Dr. Ernest N. Patty has been named as the new president of the University of Alaska, effective in September. A member of the first faculty of the University of Alaska in 1922, he established its School of Mines as one of the best in the nation and was its Dean from 1925 to 1935. A graduate of the University of Washington with a B.S. in geology and mining, Dr. Patty returned in 1928 to take a professional degree in mining engineering. He received an honorary Doctor's degree from the University of Alaska recently.

Dr. Patty is a principal in the ownership of two large Alaska gold mining companies, Alluvial Golds and Gold Placers.

Warren K. Finn has been appointed superintendent of fee interests for the Mesabi Mineral Association to succeed the late **Charles D. Kerr. Chris Mayer** is chief engineer.

G. J. HOLT, who succeeds C. W. Allen as general manager of the mining department of Cleveland-Cliffs Iron Co. with headquarters at Ishpeming, Mich.

A. M. Walker, formerly with Barnat Mines Ltd., is now general superintendent at Campbell Chibougamau Mines Ltd.

Scroop W. Enloe, Jr., of Spruce Pine, N. C., mining industry leader, has been reappointed by Governor William B. Umstead as a member of the North Carolina State Board of Conservation and Development. He is chairman of the Board's Mineral Resources Committee.

Richard L. Stewart has been appointed assistant director of public relations of the Utah Copper Division of Kennecott Copper Corp. Mr. Stewart, who has been affiliated with the company since 1939, succeeds **C. R. Naylor.** Mr. Naylor was recently appointed superintendent of the Garfield Improvement and Garfield Water Companies, operating affiliates of Kennecott.

The Consolidated Mining and Smelting Company of Canada, Ltd., announces the appointment of **J. M. Buchanan** as special assistant to the superintendent at Trail, B. C. Mr.

IT'S JUST THAT SIMPLE. There's only one reason in the world why so many wire rope users in the mining field prefer Roebling wire rope... *it costs a lot less on the job than any other.*

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RALPH D. PARKER, who has been elected president of Canadian Nickel Co., Ltd., the subsidiary of the International Nickel Company of Canada, Ltd., which conducts its exploration and prospecting program.

Buchanan holds a B.Sc. in metallurgical engineering from the University of Washington and has been associated with the company since 1941, with several years interruption for army service.

Alfred R. Flinn, assistant superintendent of the New Jersey Zinc Co.'s Sterling mine, Ogdensburg, N. J., since 1943, has been transferred to the New York office as resident mining engineer. He has been with the company for 38 years and served previously at the Austinville, Va., property.

B. A. Thomson is employed by Algoma Ore Properties Ltd., Jamestown, Ontario, as engineer-in-training.

Albert Henry is employed as mining engineer by Cleveland-Cliffs Iron Co. at Ishpeming, Mich.

Formerly with Combined Metals Reduction Co. as research metallurgist, **Robert M. Wigglesworth** is now at Black Rock Mining Corp., Bishop, Calif., in a similar capacity.

J. T. Shimmin, Jr., is shift foreman of the magnesium department of the Titanium Metals Corporation of America, Henderson, Nev.

The University of Illinois college of engineering announces the following promotions in the field of mining and metallurgy: **George B. Clark** was advanced to professor and **John W. Marx** to associate professor.

Robert Devlin, now manager of Asbestos Corp., Ltd., was formerly consulting engineer for the mine financing firm of Robertson and Morgan, Ltd.

J. Y. Cote is analytical chemist at Brunswick Mining and Smelting Co., Bathurst, New Brunswick. He was formerly working in metallurgy at Beattie Duquesne Mines.

Edwin H. Spencer is geologist at Consolidated Mining and Smelting Co.'s Bluebell mine, Riondel, B. C.

Formerly employed as mine foreman for the Resurrection Mining Co. at Leadville, Colo., **Jack Hawn** now holds a similar position at San Francisco Chemical Co.'s Cumberland tunnel at Montpelier, Idaho.

E. Warren Peterson of Ishpeming, mechanical engineer, has been appointed superintendent of Inland Steel Co.'s Sherwood mine at Iron River. He succeeds **R. O. Marston.**

J. Fred Williams, Jr., associate professor of metallurgy at Washington State College, will be a member of a team which Stanford University will assemble under an agreement with the Mutual Security Agency to build a metallurgical program at the University of the Philippines. He is being granted a year's leave of absence for this international teaching and curriculum building assignment.

In Peru, **R. Maas** has left his position as assistant mine foreman for Cerro de Pasco Corp., at Morococha to become mine superintendent for Consorcio Minero del Peru, S. A., at Calpa mine.

JOHN H. KEARNEY has joined *E&MJ* as news editor. Mr. Kearney is primarily a newspaperman, having been a reporter on major dailies for 10 years. He attended George Washington University in Washington, D. C. Much traveled, he has visited 18 foreign countries and came to this staff from his post as a press attache at the U. S. Embassy in London.

Hernán Danús V., formerly a mining engineering student at the Universidad de Chile in Santiago, is now geologist for Compañía de Acero del Pacífico in northern Chile.

Roger M. Blough, vice chairman of the board of directors of the United States Steel Corp., has been elected general counsel by the directors to succeed Nathan L. Miller who died recently. Mr. Blough will continue as vice chairman of the board, an office he has held since May, 1952. He is also a member of the corporation's finance committee.

D. Moreno and **E. H. Monroe** will staff the Mining and Metallurgical Division of Brown & Root, Inc., with offices in New York City. The new office of the Houston firm will offer

DR. E. W. DAVIS, director of the Mines Experiment Station of the University of Minnesota, for whom the new "E. W. Davis Works" taconite plant of the Reserve Mining Co. has been named.

engineering, process designing, consulting and construction services to the mining industry. Mr. Moreno and Mr. Monroe are both mining engineers of long and varied experience.

R. C. McMurchy has recently opened a consulting office at Noranda, Quebec. Graduate of the University of Manitoba with a B.Sc. and holder of a Ph. D. from the University of Minnesota, he has had extensive experience in Quebec, but plans to work in the future in all parts of Canada.

Everett L. Joppa has been appointed manager of ore mines for Pickands Mather & Co., succeeding **Kenneth Duncan,** who retired July 1. Mr. Joppa has been with the company since 1928 and has served on the Cuyuna, Gogebic and Mesabi ranges. Other appointments include: **Otto L. Yauch** as manager of engineering; **John Englund,** mining engineer and metallurgist as member of the metallurgical staff at the Erie laboratory, Hibbing, Minn.

C. O. Rudstrom, superintendent of Snyder Mining Co.'s Shenango mine and assistant superintendent of the Whiteside mine became general superintendent of the company's Mesabi range mines July 1.

Fred D. Vines, assistant chief engineer, has been named chief engineer of the M. A. Hanna Co., Cleveland, to succeed **Robert S. Walker** who has been made consulting engineer. **Kenneth Weber** has joined the company's engineering staff at the general office in Hibbing, Minn.

H. I. Altshuler, formerly general manager of the Frontino Gold Mines, Ltd., of Colombia, South America, has returned to take up residence in the United States after many years of foreign operation.

Eugene L. Peterson has been promoted to manager of advertising and sales development of Athey Products Corp., after a year of service with this Chicago firm.

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FARVAL—*Studies in Centralized Lubrication* No. 151

THIS new 20-page databook brings you up-to-date on centralized lubrication. In words, pictures and diagrams, Bulletin 26 shows you how simply and economically Farval systems operate.

The step-by-step operation of the unique Farval Dualine valve is presented in a series of color drawings. Its outstanding features are discussed. Detailed information on Farval systems is given, including manual systems, heavy-duty automatics, the compact automatic DC 20 specifically designed for smaller machines and the Spray Valve system designed to lubricate open gearing and slide surfaces evenly.

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Bulletin 26 also summarizes briefly the experience of Farval users. On many machines Farval eliminates 45 minutes or more out of every hour of hand-oiling labor. Farval protects bearings, thereby reducing the expense of dismantling machines. By keeping equipment steadily at work, Farval increases machine production. Farval saves 3 of every 4 pounds of lubricant used by other methods. In short, the economies due to Farval centralized lubrication usually pay for the installation in a few months and continue thereafter to pay handsome dividends.

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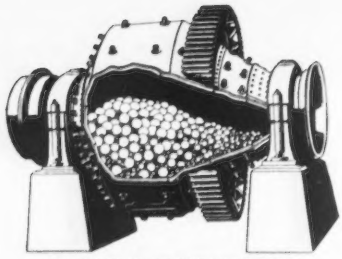
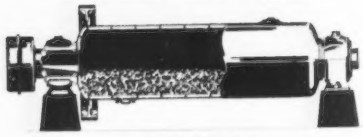
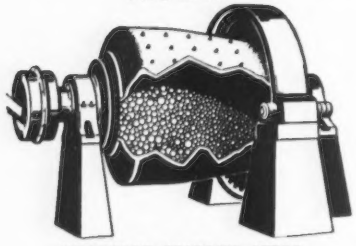


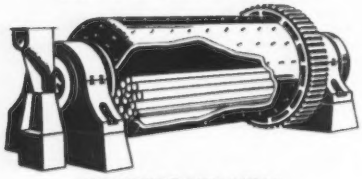
HARDINGE CONICAL MILLS



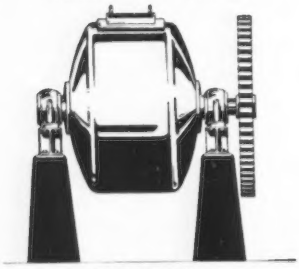
TUBE MILLS



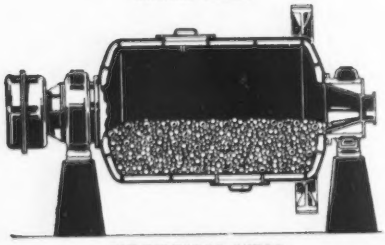
HARDINGE TRICONE MILLS



HARDINGE ROD MILLS



BATCH MILLS



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Personal News *(Continued)*

Merle H. Guise has returned to his Yonkers, N. Y., headquarters after an extensive examination of various metals in Brazil.

Beaverhead Mining Assoc., Dillon, a chapter of the Mining Association of Montana, elected the following officers for the ensuing year: **John Hand,** Argenta, Mont., president; **Clifford Renz,** vice president; **Bruce A. Risley,** secretary and **John Collins,** treasurer. The last three named reside in Dillon, Mont.

OBITUARIES

Francis L. Stephenson, 62, died on July 24 at Asheville, N. C., while attending a convention of the Southern Fabricators Assoc. He had been manager of structural steel sales for Bethlehem Steel Co. He received a degree in mining engineering from Lehigh University in 1916 and had been associated with Bethlehem Steel since 1927.

William S. Miller, 85, died at the Nyack (N. Y.) Hospital on July 27 after a long illness. A graduate of the Colorado School of Mines in 1890, Mr. Miller retired in 1941 as superintendent of the Tompkins Cove Stone Co., a position he had held for many years.

James J. Russell, chairman of the board and former president of Revere Copper and Brass, Inc., died Aug. 1 after suffering a heart attack on the previous day in Grand Central Terminal, New York. He was 67 years old.

Born in Rome, N. Y., he went to work for Rome Brass & Copper Co. as office boy after graduating from public school. He became treasurer when Rome Brass and Revere were merged in 1928. In 1947 he was elected president, and in 1951 chairman.

William M. McClean, 83, Montana mining engineer, died July 30 in Hot Springs, Mont. A graduate of Purdue University, he was associated with mines in the Helena and Marysville areas and later practiced his profession in Peru.

George Austin, 80, principal owner of the Jumbo gold mine in the Awakening district near Winnemucca, Nevada, died July 20 in Reno. Mr. Austin began his career in the gold mines of California's Mother Lode country. Later he carried on several mining enterprises in Nevada.

G. P. Lord, 65, who retired last May as general manager of the Mexican Mining Dept. of American Smelting & Refining Co., died in Boston on August 9. Long associated with the company, Mr. Lord had a mining engineering degree from the Massachusetts Institute of Technology. He had been in the Mexican division of Asarco since 1925, and had been in other divisions of the company before that time.

Outstanding New Manual

Manual on Rock Blasting. Editor in Chief, Dr. K. H. Fraenkel, Swedish State Power Board, Stockholm. Published by Atlas Diesel Co., Stockholm, Sweden, and Sandviken Steel Co., Sandviken, Sweden. Price $15, or the equivalent in foreign currencies. It may be ordered from Atlas Diesel Co., Stockholm, or through nearest representative.

This loose-leaf manual printed in four languages—English, French, German, and Swedish—is unique in the literature of mining technology. Each pair of facing pages presents the four parallel versions in as many columns to the reader, the English text leading at the left. The 19 chapters, on as many topics and prepared by 15 authors, cover 482 7 x 10-in. pages, all contained in a stout binder. Eleven more chapters, to be inserted in the volume, are promised for this year. The book is intended for construction and mining engineers.

The editorial board of nine members that is supervising the production of this interesting volume under the chairmanship of Dr. Fraenkel, includes J. Hedlund, managing director of the Swedish Mining Association, B. Hjortzberg-Nordlund, chief engineer of the Grangesberg Mining Co. (which jointly with the Swedish State owns the Luossavaara-Kiirunavaara and the Malmberget companies), and Erik Ryd, Atlas Diesel Co.

The objective of the editors, according to Dr. Fraenkel, is to produce a treatise, with the assistance of specialists in various countries, that will be accepted as a standard international handbook for engineers faced with rock-blasting problems in the mining industry and elsewhere. The rapid technical advances of recent years, not the least among which has been the introduction of tungsten carbide as a drilling medium, appear to make such a volume desirable.

A better idea of the contents may be obtained from the following selected chapter headings:

"Factors Influencing Blasting Results" and "Rock Blasting Methods in Tunneling," both by Dr. Fraenkel.

"Calculation of Time Consumed in Rock Drilling and Blasting," by S. Wallin.

"Methods for Testing the Drillability of Rocks," by H. Sievers.

"Planning of Rock Blasting Operations in Civil Engineering," by A. Kallin.

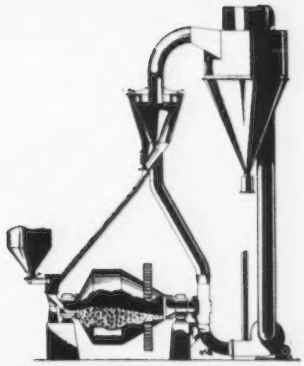
"Practical Drilling Patterns," by Dr. Fraenkel.

"Swiss Experience in Driving Headings and Tunnels Through Unstable Rock," by C. Andreae.

"Notes on Hard Metals for Rock Drill Steels," by B. Gisner.

"Physical Properties of Explosives" and "Nitroglycerine Explosives," both by A. Nilsson.

Also "Explosives," by K. Trautzel; "Firing Electrically," by C. Johansson; "Short Delay Blasting," by K. Trautzel; "Ventilation," by R. Loison.



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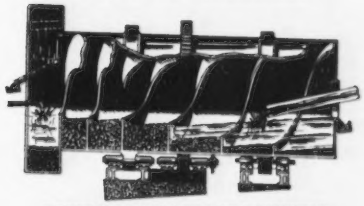

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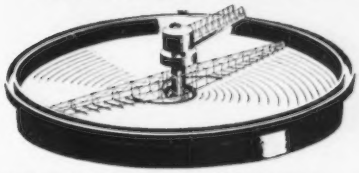

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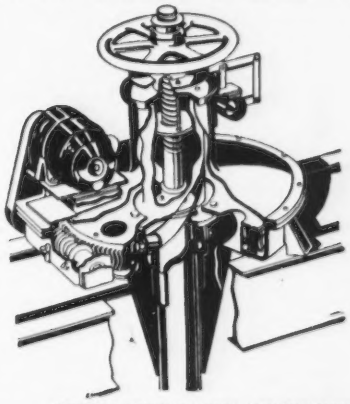
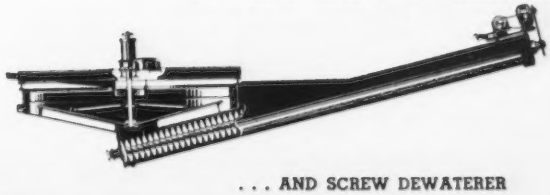


. . . WITH "AUTO-RAISE" MECHANISM

Bulletin 17-B-1 classifying; Bulletin 39-B-1 wet classifying.



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THIS MONTH

THESE HAPPY PEOPLE, attending the 50th anniversary meeting of the Idaho Mining Association at Sun Valley, Idaho, smile so cheerfully because they are comfortably aware of doing something constructive in as thoroughly enjoyable a manner as possible. Harry Marsh, Association secretary, who presided, is sixth from left in the front row.

State's Resources, Lead-Zinc Outlook Feature Idaho Association's Jubilee

DESPITE SOME DISAGREEMENT on how zinc should be priced, the more than 600 mining men and women who attended the Golden Anniversary meeting of the Idaho Mining Association at Sun Valley, Idaho, July 13 to 17, reached enthusiastic accord on at least one item: Sun Valley is a wonderful spot to hold a meeting.

Papers and discussion of problems took up each morning of the four-day meeting, but after lunch the group adjourned to the golf course, the swimming pools, the skating rink (ice), or to a quiet nap. Such discussion as took place thereafter concerned the relative merits of various sunburn lotions or how to get the ball across the creek on the second hole and still keep it on that corkscrew fairway.

There was a rumor around that one otherwise capable miner drove nine balls into the creek on the sixth hole, one after the other, then borrowed a tenth ball and with a mighty heave threw it safely across.

Wormser Makes Point

Headlining the formal sessions was a paper presented by Felix E. Wormser, Assistant Secretary of Interior for mineral resources. He outlined the drift to government control of industry, but pointed out that government aid could be valuable, as in alleviating the present hardships of lead and zinc miners. (See *E&MJ*, Aug. 1953, p. 131.)

In summing up the outlook for lead, Robert L. Ziegfeld, secretary of the Lead Industries Association, pointed out that although current lead consumption is at a high level and the metal is in a comfortable position statistically, the future will require an intensive search for new markets and expansion of old ones in order that lead may hold its own against competition.

Similar Warnings Sounded

Similar warnings were sounded by Ernest Gent, executive vice-president of the American Zinc Institute. He pointed out that imports were at a rate more than double that of 1952, accounting for the low domestic price at a time of heavy consumption. Even more strongly than for lead, zinc needs work to find new markets and to expand old ones, Gent said. He felt that the turn of the cycle was near for zinc, however, and that an upturn was in sight.

In reviewing the position of gold, Donald N. McLaughlin, president of Homestake Mining Co., suggested the Administration be urged to: 1, remove the present restrictions on ownership of gold by American citizens; 2, to terminate the sale of gold by the Treasury to so-called industrial users. He felt the first point would give the public a weapon of defense against "the power of the money managers." The second would correct a procedure by which, he felt, the gold producers are "virtually forced to subsidize the industrial users of gold."

An interesting calculation of the total cost of a stope miner, as against the basic wage rate, was presented by Messrs. Simons and Brown of the Sidney Mining Co. It is presented in full in this issue.

Idaho Mining History

J. E. Berg, American Smelting & Refining Co., read Henry L. Day's excellent summary of "93 Years of Mining In Idaho." It should serve as a fruitful reference work for students of the history of the state.

The great potential value of natural gas to the Pacific Northwest was reviewed by H. R. Seykota, of the Portland Gas & Coke Co., who said a line might be in from Canada by late 1955. He felt the use of gas for fuel should be of great value in the State's smelting industries.

Growth of the State as a producer of placer-sand rare minerals, such as monazite, bastnasite, thorium minerals, etc., was covered by A. J. Kaufman, Jr., of the USBM at Albany, Ore., who also touched on methods of producing metallic titanium and zirconium. He forecast growth in use of metallic zirconium, although its present cost of $5 to $10 per lb. will

IN MINING

no doubt have to be lowered first.

J. B. Philipson, from the Idaho Falls office of the AEC, told of the activities at the Arco reactor testing station. These include: conversion of atomic into electrical energy; development of breeder reactors; testing of materials that can stand up as parts of atomic reactors; development of methods for recovering uranium from waste products of the plant; testing of atomic engines for submarines or aircraft.

He mentioned that finding the right materials for building reactors was a tougher problem than finding the uranium raw material. He added that he foresaw no likelihood of the supply for uranium ever outrunning the demand.

Claims Laws

In the panel on the mineral land laws, there seemed to be general agreement among the group that there needed to be a more rigid enforcement of the present laws rather than a drastic change in them. It would be useful, however, to have all claims recorded so that one could tell beforehand what claims had been staked in any given area.

In its adoption of policy, the Association called for: protection of domestic industry against unfair competition from imports; opposition to a nationalization of mineral resources; endorsement of the Dworshak Bill and opposition to the Anderson Bill, both dealing with the land laws; repeal of the excess profits tax and adoption of certain other tax benefits to mining; aid in building mine access roads; a return to free circulation of gold and continuance of the present silver policy; increased activity in mining's public relations work; greater aid to antimony; approval of the Snake River power development; investigation of Idaho's blue sky law.

Brazilian Manganese Ore Deposits Would Be Developed Under U. S. Steel Contract Awaiting Vargas' Approval

LONG-DELAYED DEVELOPMENT and exploitation of the immense manganese ore deposits at Urucum, state of Matto Grosso, by the United States Steel Corp. has at last been made possible by a Brazilian government ruling, offered to President Vargas for final approval.

Although U.S. Steel for several years has been prepared to begin work at the remote location on the borders of Brazil and Bolivia, development had been held up by Brazilian concessionaires who sought to act as middlemen. Now, the Brazilian Federal Frontier Commission has approved a new contract directly between the state of Matto Grosso and the company. The Commission entered the picture because Brazilian law severely restricts foreign activities in its border zones.

Highlights of the contract are:

Matto Grosso state will draw a 3% royalty on the price of the first 250,000 metric tons of ore moved to seaport, and 3.5% royalty on the balance.

U.S. Steel will advance Matto Grasso state Crs. 10-million (roughly $500,000 at the official exchange rate) within 60 days of signing the contract. Another equal amount reportedly has been paid already. This $1-million advance will be amortized from ore shipments.

U.S. Steel is obliged to produce a minimum of 50,000 metric tons annually.

U.S. Steel is obliged to invest 20% of its net profits within the municipality of Corumba, the nearest municipality to the deposits. A plan for this investment is to be prepared for approval by state authorities.

The contract runs for an initial period of 50 years, and is renewable for another 50.

Early action on the development of the orebody is very likely. For more than a year it has been stated in Brazil that international lending organizations are prepared to offer funds in excess of $20-million to the project. The proposition is far from a simple one, however. The Urucum-Corumba region lies more than 1,000 rail miles west of Sao Paulo, and most of the line in the interior is a tenuous single track through the jungle.

Preliminary information is that U. S. Steel will have to move the ore by barge down the Rio Paraguay, to the Rio Parana, and eventually to the Plate Estuary—a round-trip of something over 3,000 miles subject to seasonal river level fluctuations.

The pact has special significance in the context of Brazilian policy. Traditionally, Brazil has sought to foster the interests of its own nationals in the mining field and has been insisting that large-scale ventures like this one have a majority of Brazilian capital and control. This was followed in the contract between Bethlehem Steel and Brazilians for the development of the manganese deposits in Amapa Territory, in the Amazon Basin. So the U.S. Steel contract, with no announced participation by any Brazilian interests is an important milestone in Brazil's development of its natural resources. That tradition has been broken in this case might be a sign that more generous attitudes will prevail in the development of another far more important potential resource—petroleum.

Highlights in the News

Exploration has disclosed that a new uranium area, the Bull Canon district of Montrose County has what appears to be one of the largest deposits of carnotite ore yet found on the Colorado Plateau. Page 139.

Sentinels of Safety award was won by Pickands Mather & Co.'s Buck group for the best safety record during 1952 among underground metal mines. Page 144.

Zonolite Co. has developed a new treatment process which will make it possible to utilize lower-grade ores at its vermiculite mine near Libby, Mont. Page 148.

Tungsten mines in Utah are reported expanding their operations because of the establishment of a new refinery —the Salt Lake Tungsten Co. Page 156.

Kaiser Aluminum & Chemical Corp. broke production records during the first six months of 1953 at its Mead and Trentwood plants near Spokane. Page 158.

Two major mining companies in the Coeur d'Alene district believe that use of natural gas will permit cheaper operation. Page 162.

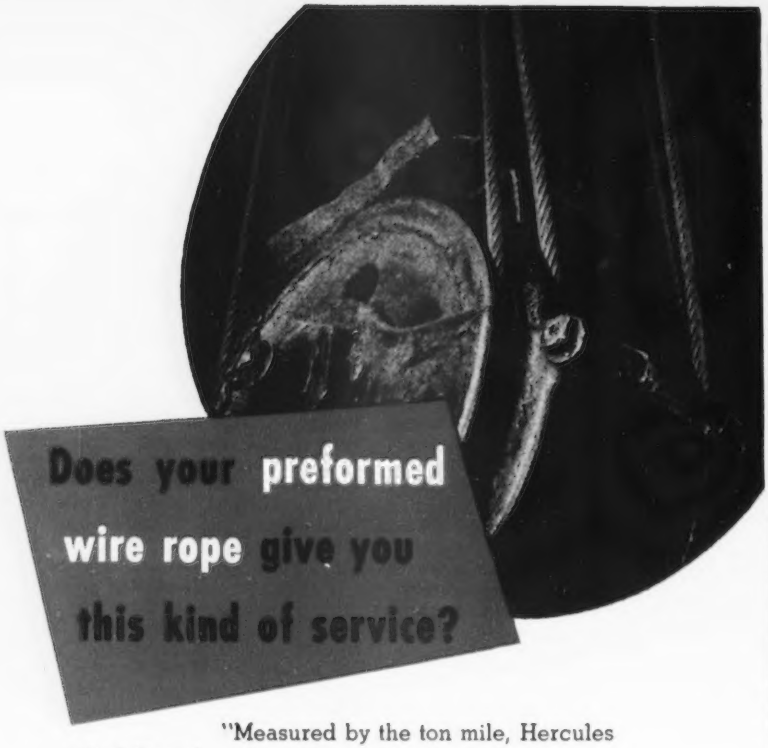
A northern British Columbia copper gamble appears to be paying off for the Granby Consolidated Mining, Smelting & Power Co. Page 170.

There's an estimated $14-million market for spare parts to maintain construction and mining machinery in Brazil. Page 188.

Movements are astir in Austria to begin organized mining of the Tyrolean Wipp Valley's vast deposits of natural kyanite. Page 190.

Turkey expects increased exports of copper now that its Murgul Copper Mine is now in full operation. Page 194.

Tin mining companies in Nigeria have achieved a relatively satisfactory position despite tin price setbacks. Page 197.



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Cramet-DMPA Pact To Boost Titanium Sponge Production

CRAMET, INC., of Chicago, has contracted with the Defense Minerals Procurement Agency to produce 6,000 tons of titanium sponge annually. The contract with Cramet, wholly-owned subsidiary of Crane Co., Chicago, calls for output of 30,000 tons of the sponge over five years.

DMPA is to advance the company up to $24,950,000 for construction and equipment. The advance is to be repaid with interest as the sponge is produced. The contract calls for construction of a $25-million plant. Final selection of a plant site has not been made but a location near Nashville, Tenn., is under consideration.

Clearing Underway At Projected Site For Taconite Plant

SOME PRELIMINARY CLEARING of the surface is being done for Erie Mining Co. on ground north of Mesaba Station in Minnesota, on the eastern Mesabi, where Erie is expected to erect its 10½-million-ton plant for concentrating taconite. This work is being done by Peter Kiewit & Sons, contractors. No announcement has been made thus far by Erie as to when it will start this $300-million project. The company's 200,000-ton pilot plant at Aurora, on the Mesabi, is now in its sixth year of operation with commercial size equipment. Bethlehem Steel and Youngstown Sheet & Tube are the owners of Erie.

Safety Report Shows Mining Accidents Increase

WHILE THE 1952 INJURY RATE for all industries was lower by 7% that for "mining, except for underground coal" showed an increase of 11%. Average rate for all industries was 8.40; that for the above-mentioned category of mining was 24.58. The severity rate, however, for this type of mining was down 3%.

These statistics were released by the National Safety Council, Chicago, which noted generally that workers employed in 1952 by member companies enjoyed the safest year on record. There were two categories of industry which had higher accident rates than "mining, except underground coal." These were "mining, underground coal" and lumbering.

Safety Congress Program

SYMPOSIUMS ON TRAINING METHODS and on roof bolting will highlight mining sessions at the 41st National Safety Congress and Exposition in Chicago October 19-23.

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ALASKA

★**Two new antimony deposits** at Cape Caamano in southeastern Alaska may prove of commercial size, according to George Roberts, manager of Tilicum Mining Co. He credits a new prospecting technique for discovery of the ore which was covered in places with muskeg as thick as 5 ft. A shaft is now being sunk after surface trenching and drilling had been done. The work is being done by the company with the help of Federal loans.

★**Bear Creek Mining Co.**, subsidiary of Kennecott Copper Corp., has members of its Spokane staff prospecting for copper and zinc near Orange hill, about 200 miles from Cordova and 50 miles from the nearest town. The campsite is at a 4,000 ft. elevation. The party, headed by Glenn C. Reed, was flown in from Cordova by a "bush" pilot who returns every five days with mail and supplies. Mr. Reed resigned recently from the Spokane office of the U. S. Bureau of Mines to become field engineer for the company.

★**Donald M. Fraser**, chief geologist for Bethlehem Steel Corp., finished surveys in July at Snettisham iron deposit at Klukwan, 40 mi. southeast of Juneau, and is reported to have said, "The only question is the extent of the deposit." He reported at Juneau that his company keeps informed of current discoveries and developments. James A. Noble, professor of geology at California Institute of Technology, and a consulting geologist for U. S. Steel, is also conducting surveys in the Klukwan area. Quebec Metallurgical Industries, subsidiary of Ventures Ltd., has a group of engineers, supervised by Dr. Alex Smith, Vancouver, B. C., doing geophysical and exploratory work there and has optioned claims from Alaska Iron Co. of Seattle. E. C. Robertson, a government geologist, is in the area for a one-month survey. The government had worked there previously and had dropped the work.

COLORADO

★**There is** more new activity in tungsten mining and prospecting than in any other phase of Boulder County mining. Almost $20,000 worth of tungsten is being mined each week in the Nederland area, much of it from outcrop ores and in a few cases with sluice boxes.

Shenandoah-Dives Mining Co., despite efforts to conserve cash during its period of suspended operation because of low zinc-lead prices, announced a net loss for the five months ended May 31 of $66,635. In the first half of

1952 there was an operating profit before taxes of $158,807.

★**Golden Cycle Corp.** of Colorado Springs will spend a considerable sum to develop its new Colorado uranium leases and believes the venture will be a profitable one. To develop its uranium lease near Uravan, Golden Cycle will sink a two compartment 650-ft. shaft to the top of the ore deposit, install a hoist, bring in power and equip the mine.

★**It is estimated** that there were 452 uranium mines and prospects in operation in the four-state area of the Colorado Plateau in 1952, an increase of 152 over 1951. In the first quarter of 1953, uranium production in Colorado was four times the output in the same period of 1952. Colorado Plateau uranium development is described as a $56-million industry including capitalization, payrolls and purchases.

★**Robert L. Jones,** Leadville mining operator, has leased the Resurrection mill and part of this mining property and announces that limited operations are to be restored. The Resurrection company recently closed the mine and mill because of low metal prices. The Resurrection mill reportedly is the only mill in Colorado that does custom milling for independent lead and zinc miners. Re-establishment of operations at the Leadville mill will save the independents from paying freight rates to ship their ore to Utah. Mr. Jones said that, in addition to operating his lease at the Resurrection, he plans to start operations at the Garibaldi lease, which he owns.

★**Exploration** has revealed that one of the new uranium areas, the Bull Canon area of Montrose county, has what appears to be one of the largest deposits of carnotite ore yet found on the Colorado Plateau. Three mining camps have been opened in the Bull Canon area by Consolidated Uranium Mines Inc. The company's newly introduced method of drilling mine shafts was one of the discussion topics of members of the new uranium association. A special rotary drill sinks a three-foot shaft to the underground deposit. Hoisting buckets fit the shaft somewhat in the same manner as a bullet fits a rifle barrel. E. G. Frawley, Consolidated president, said the round shafts have proved cheaper to sink than conventional mine shafts, costing around $30. per ft. and requiring no timbering. They may be sunk more quickly, he added.

★**At Silverton,** the U. S. has approved a mine development loan of $210,900 to Shenandoah-Dives Mining Co. This amount is 50% participation by applicant and 50% participation by government. The loan will allow the company to drive 3,000 ft. of tunnel and certain other work preparatory to actual mining operations.

★**Work at** Golden Cycle Corp., manager Carlton reports, is progressing sa-

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Colorado (*Continued*)

tisfactorily on the Ajax mine at Cripple Creek, with good tonnage coming from the big Bobtail stopes on the 30th and 31st levels.

★**Climax Molybdenum Co.** mine at Climax will be the world's second largest underground metal mine upon completion of the current expansion program, company officials say. An average of 23,000 tons of ore is being removed each day from Bartlett Mountain at present. With completion of the multi-million dollar construction program now underway, production will be increased to approximately 28,000 tons per day.

★**Saguache Smelting Co.** is building a mill and smelter combination at this central point among famous old time Colorado mining districts. The project is getting well under way for the milling and smelting of all types of ores in the Saguache region.

★**The Silver Shield mill,** just north of Ouray, has started operation. The mill was recently leased by the Colvin interests to treat their ore.

★**Work has started** in Illinois Gulch at the Pittsburg Placer. A dragline is being used to expose a surface vein of gold-lead ore. Indications of this vein were first found during hydraulic operations in the gulch.

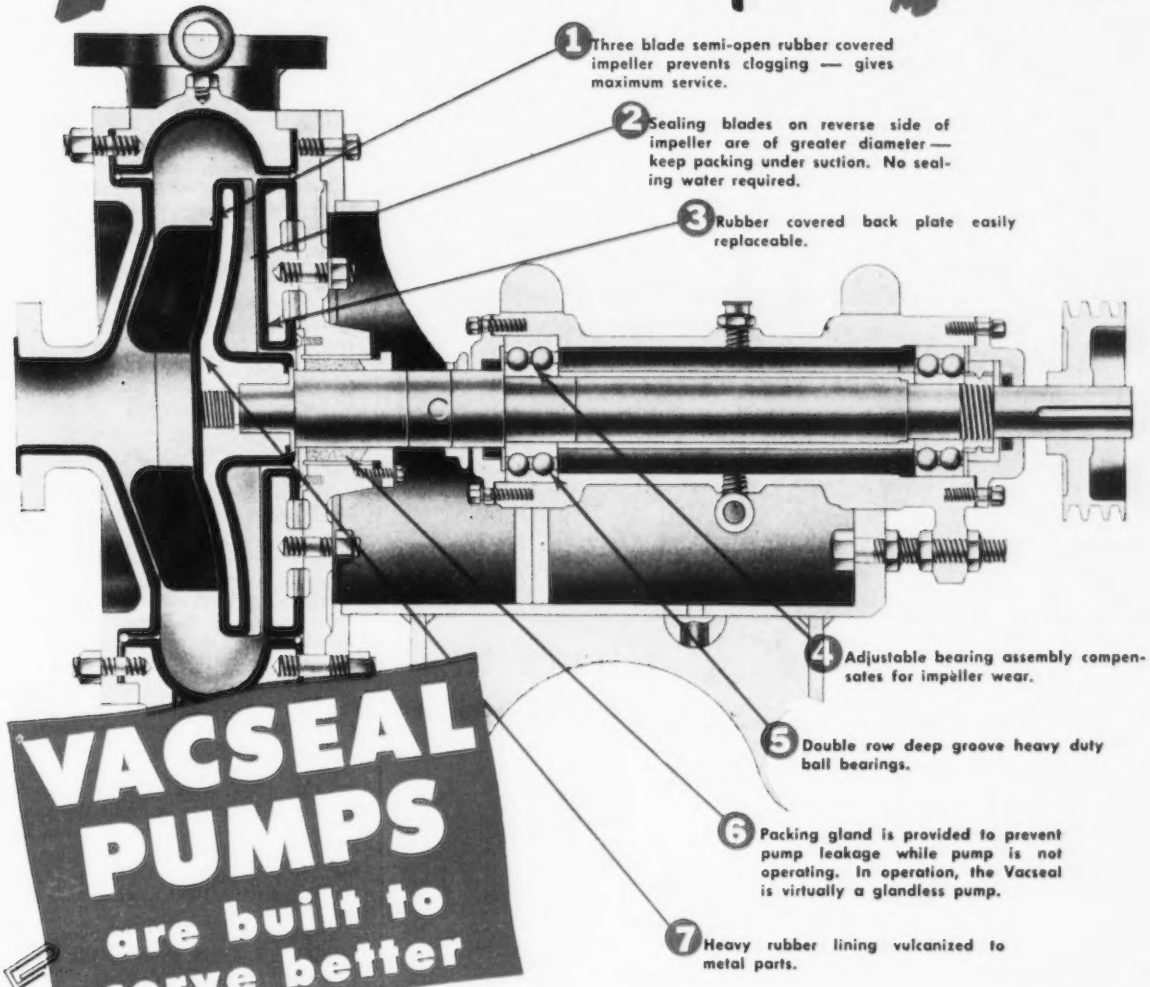
★**Colorado Fuel & Iron Corp's.** Pubelo plant, largest of the firm's 12 plants, in June broke existing daily and weekly pig iron productions of the company. Previous existing daily average of over 3,000 tons was established last May. The company has newly-installed ore-crushing facilities.

★**Annual meeting** of the Clear Creek Metal Mining Association was held in Georgetown. O. Barlow Wilmarth read an excerpt from a letter of President Eisenhower in which the President stated: "I hope that the administration may find a way of relieving the depressed conditions that prevail in many mining districts. The Interior Department in particular has been asked to devote its energies in that direction."

FLORIDA

★**W. A. White,** president, Titanium Corporation of Florida, at Sebastian, announced that he has a pilot plant in operation on his own property there to process 300 tons of beach sand per day for ilmenite, rutile, zircon, monozite, garnet and staurolite. Exploration work has been underway for about two years and has developed 1.2-million tons averaging 6% plus of the minerals, White said. When further exploration work is completed on an adjoining and larger tract which he owns also, White said that he plans to increase production to 6-700 tons daily.

7 features that equal 1 fact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6 Packing gland is provided to prevent pump leakage while pump is not operating. In operation, the Vacseal is virtually a glandless pump.
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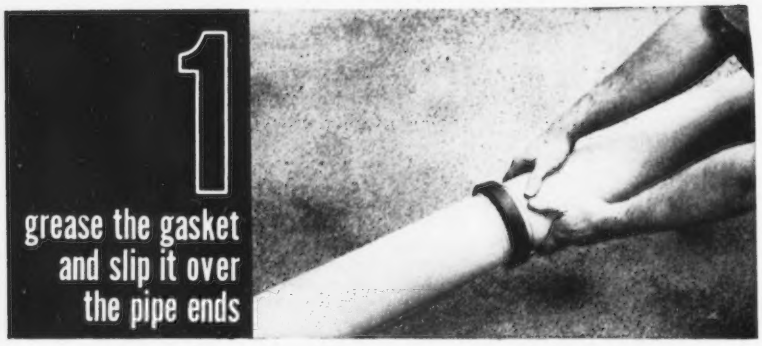

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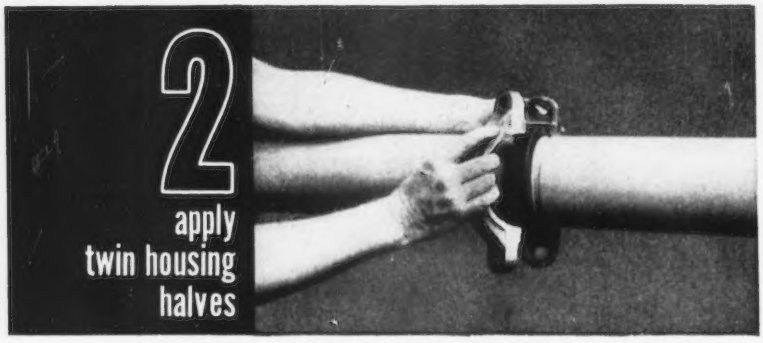

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GEORGIA

★**Georgia Iron Works, Augusta,** has been licensed to manufacture Meehanite metal to bridge the gap between cast iron and steel in the production of its line of pumps for mining operations. The company will use Meehanite in all equipment to replace semi-steel casting.

The company has modernized its foundry and installed the latest in automatic sand handling equipment. Plans are now under way to increase the capacity of its machine shop.

IDAHO

★**Highland - Surprise Consolidated Mining Co.** has opened a 50-ft. length of ore carrying high lead values on its new 1650-ft. level and is continuing to drift westerly along the Surprise vein structure toward the projected downward extension of another orebody, which, according to indications on the 1450 level, should lie about 500 ft. farther west. Meanwhile, crosscutting toward the vein on the 1850-ft. level has been started and is expected to reach the vein about the first of October.

Deepening of the shaft and establishment of the two new levels was done under a $200,000 DMEA contract which was recently increased by $82,000 to provide for additional development on the lower horizons.

The contract extension also provides for additional diamond drilling on the 1300 level in the easterly portion of the mine to probe the hanging wall of a small stoping area for parallel structures. Exploration of the downward extension of this small orebody on the 1650 level is also contemplated.

The Highland-Surprise property is in the Pine Creek area of the Coeur d'Alene mining district. Tibor Klosubicky is superintendent of the operation.

★**Depressed lead** and zinc prices have forced Nabob Silver-Lead company to suspend production at its Pine Creek property in the Coeur d'Alene district. Work at the mine is now being concentrated on development and preparation of orebodies for immediate production when a more favorable market situation develops. Exploration during the past 18 months has disclosed commercial orebodies both above and below the 1300 main adit level.

★**Another new orebody** has been encountered on the 800 level of the Whitedelf Mining and Development company property near Clark Fork, the second such zone to be unexpectedly opened since exploration of this new lower horizon was started early this year. The new ore was found in a faulted segment of the Pearl vein near its junction with the Pugh fault, a zone which contained no ore on the

400 level above. Channel samples from an average width of about three feet assayed about 30 oz. of silver with good lead values.

The main ore objective on the new level lies about 600 ft. beyond the recent discovery. Drifting toward this zone is now in progress.

★**Assay offices** of Day Mines, Inc., and Coeur d'Alene Mines Corp. in the Coeur d'Alene mining district are now equipped with super-sensitive radio assayers recently developed by the Atomic Energy Commission. The new mechanisms are said to be capable of detecting and measuring the approximate uranium oxide content in rock containing less than 0.05%.

★**Sullivan Mining Co.** has been granted a two-year extension—to July 1, 1955—on the date for starting underground development of the property of Silver Moutain Lead Mines, Inc., northeast of Mullan. The operating agreement concluded by the two firms last year provided for starting underground exploration on July 1 of this year but the Sullivan company requested a postponement because of the unfavorable metal price situation.

★**Lucky Friday Silver-Lead Mines** has completed deepening the off-set shaft at its property near Mullan from the 2000 to the 2400-ft. level and is now crosscutting toward the main Lucky Friday vein on a new 2300-ft. level.

★**Exploration** for cobalt-copper deposits in the Blackbird district of Lemhi county by Northfield Mines, Inc., Delaware corporation associated with a subsidiary of Ventures, Ltd., has exposed three mineralized zones on the surface and one of them has been partially explored through underground workings. The work is being done on a 45-claim group acquired under purchase option from F. W. Stevenson, formerly of Salmon, Idaho.

★**Day Mines, Inc.,** is now operating its Tamarack mine under a block-leasing system under which each leaser or leasing group works a specified block of mining ground as an independent operator and shares costs and profits with the company. The system is also being used successfully at Spokane-Idaho Mining Company's Constitution mine in the Pine creek area of the Coeur d'Alene.

★**Construction** of a new smokestack at Bunker Hill and Sullivan Mining and Concentrating Company's lead smelter at Kellogg is currently in progress. It will be 202 ft. high, slightly higher than the old one which has been in use since 1917.

★**Idaho Consolidated Mines, Inc.,** of Seattle, expected to have its Twin Peaks mine in the Salmon river mountains south of Salmon, Idaho, in production by August. Three stopes are ready to produce and four others are in preparation. Construction and equipping of a selective flotation mill capable of handling about 150 tons of ore per day is nearing completion. About $250,000 has been spent in

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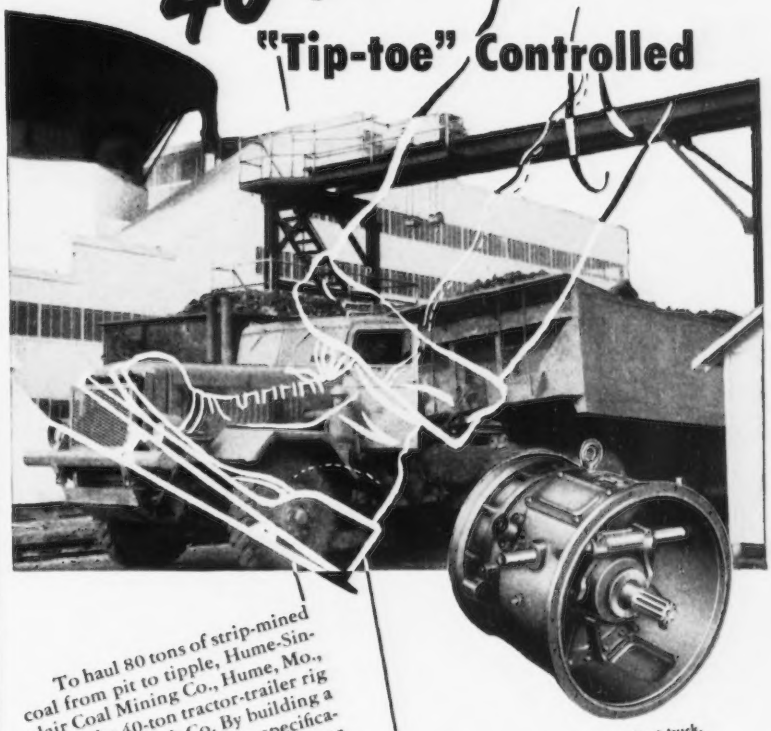

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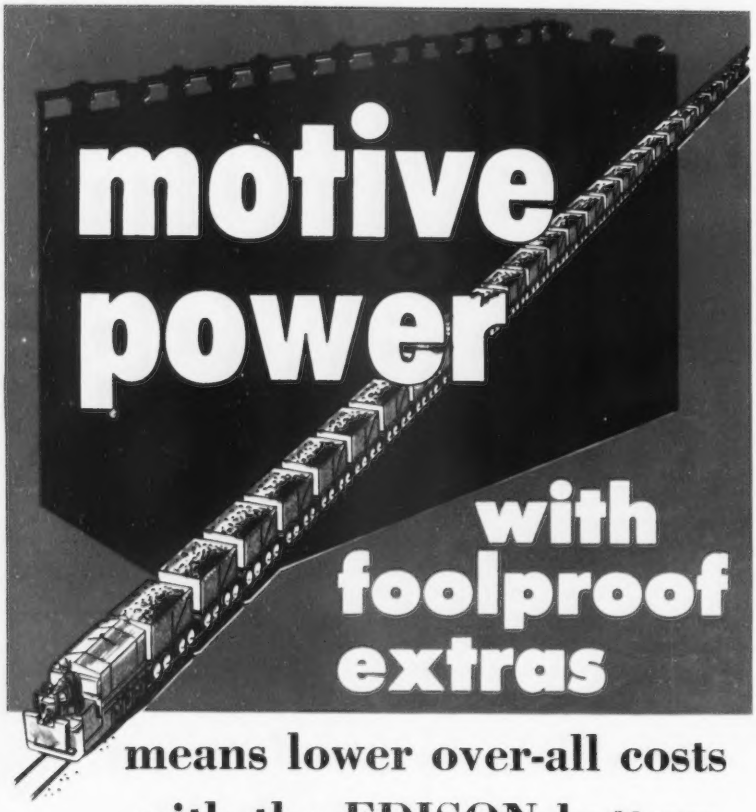

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Idaho (*Continued*)

readying the mine for production. It is a lead-silver and copper-cobalt property in the same ore zone as Calera Mining company's Blackbird mine, the nation's largest cobalt producer.

★**Silver Buckle Mining Co.** of Wallace has entered into a profit-sharing development agreement with Vindicator Silver-Lead Mining company under which it will explore and develop the Vindicator property east of Mullan, and has applied for DMEA aid.

★**DMEA project** at Idaho Mining Co.'s property on the west fork of Moon creek northeast of Kellogg has been revised to provide for additional exploration of two well-mineralized veins which have been found and partially explored on the 300 level.

★**Downhole diamond drilling** at Hypotheek Mining and Milling Co.'s East property on Pine creek in the Coeur d'Alene district has proved the downward extension of the short ore body exposed in the north surface tunnel. Two holes, one at 65 deg. and the other at 70 deg. have penetrated an eight-ft. structured "well-stringered" with ore over a strike length of about 50 ft., company officials report. Underwatering an old 300-ft. shaft in order to get under and raise on the structure is planned.

★**Clearwater Mines, Inc.,** has resumed operations after several years of idleness, at its 18-claim property on Niagara Creek in southeastern Shoshone County. About 100 tons of ore from an old stockpile on the mine dump have been sent to the American Smelting & Refining Co. smelter at Tacoma.

★**Silver Bowl Inc.** has commenced work on a new exploration program at its Stewart property on Deadwood gulch near Kellogg.

MICHIGAN

★**Shaft sinking** at the Pickands Mather's Peterson mine, at Bessemer, Mich., on the Gogebic Range, has reached about 3100 ft.

★**During the heavy rains** of early July the night shift of 50 men at Pickands Mather's Buck group of mines on the Menominee range on one occasion was brought to surface, a severe electric storm having interrupted power service. This, in addition to the rush of water which overflowed ditches, caused officials to fear that the mines might be flooded. New ditches were quickly bulldozed.

★**Sentinels of Safety** award was won by Pickands Mather & Co.'s Buck group for the best safety record during 1952 among underground metal mines. Buck employees worked almost 700,000 man-hours without a lost time accident. This record was particularly pleasing to mine officials because it included shaft sinking and shaft re-

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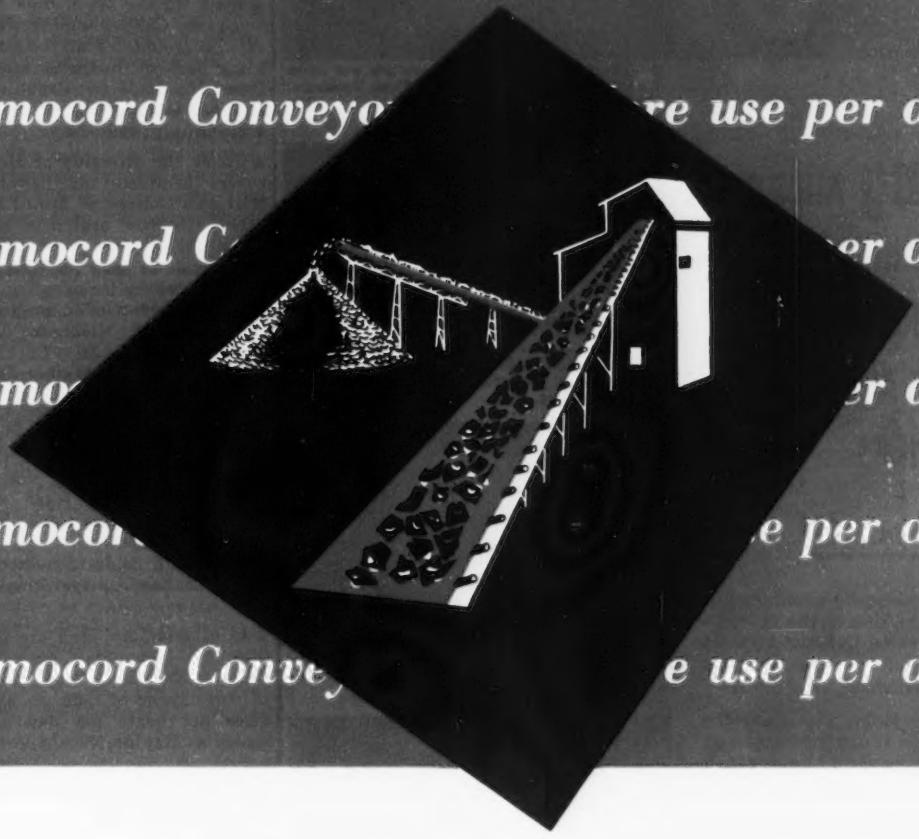

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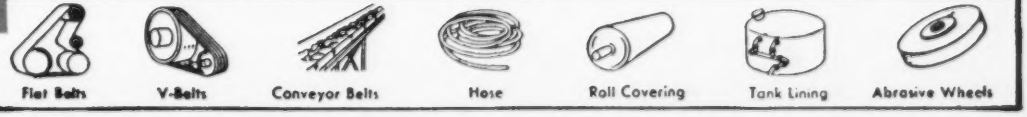

1. Orinoco Mining Company's new ore and cargo handling dock on the Orinoco River, Venezuela. Composed of 3 units, this DeLong dock is 1,130 ft. long, 82 ft. wide, and 15 ft. deep.

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The DeLong Airjacks, which are the key to the whole transformation of barge to pier, enable the dock to "climb" the steel columns, or caissons, to required elevation. After the self-lifting operation, caissons are driven to refusal for permanent installations. Caissons are welded to deck and cut off flush; then filled with concrete or sand and tops closed with welded cover plate.

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2. A week after arrival at Orinoco River site, first dock section 376 ft. long berths ship, and unloading begins. Two additional units make this pier 1,130 ft. long.

3. Loaded dock section, fabricated at an Orange, Texas yard, arriving at site on Orinoco River, after being towed across 3,000 miles of ocean. Dock carried caissons, crane, Airjacks, compressors, generators, other installation gear.

4. Crane placing 6 ft. diam., 100 ft. long steel caissons in wells fitted with Airjacks. Crane, Airjacks and other equipment were later transferred to second and third sections for erection purposes.

5. Caissons held in position by Airjacks until dock barge is jockeyed into final position. Caissons are then dropped to river bottom and DeLong Airjacks lift dock to final elevation. Control is so precise, height of dock can be regulated to 1/32 of an inch.

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Michigan (*Continued*)

pairing at the Berkshire shaft of the Buck group and the Carpenter and Fortune Lake shafts near Crystal Falls. The general superintendent is Harold J. Richards.

★**Work** on the 30-in. pipe line which will carry Canadian oil from Superior, Wis., to refineries at Sarnia, Ont., is being pushed. On the 90 mile link between Ironwood and Crystal Falls 305 men are working 10 hours per day on a seven day week basis.

★**Under the direction** of Dr. Roy W. Drier, professor of metallurgy at Michigan College of Mines and Technology, the first organized attempt to study the ancient copper mines on Isle Royale in Lake Superior is underway. The party includes Dr. James B. Griffin, director of museums at the University of Michigan; Dr. Paul Beaubien, National Park Service archeologist; Dr. Walter White and Dr. Harvey Cornwall of the U. S. G. S., and J. C. Gannon, a Marquette business man. The expedition is sponsored jointly by Mr. Gannon and the Michigan College of Mining and Technology. It is hoped to learn who these early miners were, and how they transported the ore which seems to have had a wide distribution. The party will base its operations at Belle Isle.

★**As of mid-July,** iron ore shipments from the Menominee range iron ore docks at Escanaba, Mich., were 1,129,187 tons ahead of 1952. An average of three ore boats per day are being loaded at Bay de Noc docks.

MINNESOTA

★**M. A. Hanna Co.'s** new screening and crushing plant at the Enterprise mine is in operation. Stripping and ore loading are being done at the South Agnew mine. A 6½-cu. yd. shovel is doing the loading.

At the Morton, the Bucyrus-Erie 1150-B dragline and conveyor are stripping 21 shifts per week. A 6½-cu. yd. shovel and trucks are also stripping 10 shifts per week.

Construction work has been completed by M. A. Hanna on the addition to the Patrick beneficiation laboratory. Work on the new abrasion mill at the Mesabi Chief is well under way.

★**M. A. Hanna Co.** has leased iron ore land in Mower county, Minnesota, said to contain high-grade ore. The new leases will be operated in connection with the Hanna properties in Fillmore county (which adjoins Mower county) around Spring Valley.

★**U. S. Steel's** Oliver Iron Mining Division is erecting a washing plant at the Plummer mine, at Coleraine. The plant will produce 1,200,000 tons of concentrates per year from about 2,500,000 tons of crude ore. Shipments

will begin early in 1954. Permission has been asked of the State Conservation Department to take water from Swan river and Hill lake. The mine's tonnage is estimated at 1,680,557.

★**Premature explosions** in mine blasting are rare but they do occur. A man was killed at a Mesabi range underground mine recently when one of 25 loaded drill holes exploded prematurely. Three other men were injured.

★**Pickands Mather & Co.'s** West Hill Mining Co. began shipping concentrates from its West Hill mine early in July. The mine, on the western Mesabi, is between Jones & Laughlin's Lind mine and M. A. Hanna's Buckeye. It is estimated to contain 3,266,760 tons of ore.

★**Three Canadian iron ore** producers shipped over one million tons each in 1952: Dominion Steel & Coal Corp., Ltd., 1,420,789 tons; Steep Rock Iron Mines, Ltd., 1,274,666 tons and Algoma Ore Properties Ltd., 1,146,000 tons.

★**The fourth annual** symposium on drilling will be held at the University of Minnesota Center for Continuation Study in Minneapolis Oct. 8, 9 and 10. The names of those who will lead the discussions have not yet been announced.

★**Manganese Chemical Corp.'s** new manganese plant at Riverton, on the Cuyuna range, is nearly completed. It is being built for all-year operation at an estimated cost of about $2-million. Of this the U. S. government is to furnish $1½-million. The plant will handle 200 tons of crude ore per day.

★**Prospects are bright** for a heavy production from the Cuyuna range this season. Pickands Mather & Co., M. A. Hanna Co., Inland Steel Co., Rhude & Fryberger and Zontelli Brothers are all busy. Pickands Mather, with its Mahnomen mine near Crosby, the Sagamore to the southwest and the Rabbit Lake mine to the northeast, covers most of the active portion of the range.

Rhude & Fryberger began to operate the Pennington mine on the Cuyuna in 1945. To date they have shipped 1,044,805 tons of concentrates. Since it was opened in 1913 by the Todd-Stambaugh Co., the mine has produced 2,618,163 tons, up to the 1953 season.

Pickands Mather's big producers have been the Sagamore and the Mahnomen which have shipped over 9-million tons each. M. A. Hanna's Portsmouth mine has had a total production of 12,414,213 tons up to this year. Inland Steel's Armour No. 1 and No. 2 have shipped over 5 million tons each, the total for the two being 11,440,560 tons. Zontelli Brothers' largest producer has been the Virginia mine from which they have shipped 828,041 tons since they opened it in 1948.

★**E. W. Coons Co.** has developed and is shipping ore from a new pit called

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Minnesota *(Continued)*

the Lincoln "D" at Virginia, on the Mesabi. It is the northeast forty of the area included in the old Lincoln mine, opened by Inter-State Iron Co. in 1902 and operated by them as an underground mine until 1937, with a total production of 7,315,531 tons. The forty leased to Coons was not covered by the underground operations.

★**Pickands Mather's** Scranton mine has been the largest producer from State-leased mines for the last few years. J. & L.'s Hill-Annex mine at Calumet headed the list for a long time. The Scranton shipped 731,916 tons in 1952 while the Hill-Annex had 638,067 tons.

MISSOURI

★**New contract** with the St. Joseph Lead Co. has been approved by the United Gas, Coke & Chemical Workers Union, Local 404. Provisions in the submitted contract reportedly call for an additional three days of holiday and payment by the company of $1.50 a month for Blue Cross insurance for each employee. All provisions in the new contract were said to be retroactive to the expiration of the old contract.

MONTANA

★**The long-term** lease which Kootenay Copper Mines Inc. holds on the Green Mountain mine near Dixon, Mont., has been acquired by Amador Mining Co. of Missoula under a purchase agreement. Purchase price is $100,000, payable in royalties and a share of the gross profits.

The Amador firm has unwatered the old workings to the No. 3 level and is making preparations to sink an additional 110 ft. to a No. 4 level to explore at the additional depth the contact vein, which has produced about a quarter of a million dollars in high-grade copper-gold ore from workings less than 200 feet below the surface. Rehabilitation of the combination gravity-and-flotation concentrator at the mine is also in progress.

★**Zonolite Co.** has developed a new treatment process which will make possible utilization of much lower-grade ores at its vermiculite mine near Libby, Mont. A new plant incorporating the new milling features is expected to be completed by next spring and the company will then be able to handle at a profit the almost unlimited tonnages of low-grade material which surround the high-grade zone from which past production has been taken.

★**Zonolite Co.,** producer of vermiculite and its products with main ore reserves at Libby, Lincoln County, for the fiscal year ended March 31, 1953,

had net sales of $5,942,248 compared to $5,978,024 for the previous year, a decrease of 6/10 of 1%. Net income, however, increased to $462,779. Percentage of cost of sales to net sales declined 2.6% during the past year, resulting in savings of $175,000.

★**Amador Mining Co.** reportedly has agreed to purchase the long term lease of the Kootenay Mines, Inc., on the Green Mountain group of claims in Revais Creek Mining District, 6½ miles southwest of Dixon, Sanders County. At Green Mountain, plans are to sink the present incline shaft and rehabilitate the 50-ton flotation mill. High grade copper concentrates have been produced by the mill in the past.

★**Foley Brothers Inc.,** Pleasantville, N. Y., will be the general contractor to construct the plant of the Anaconda Aluminum Co. at Columbia Falls, Flathead County.

★**Grizzly Gold Mining Co.** of Virginia City, Madison County, was incorporated in Montana on July 1, 1953, by Joe Butzerin, William E. Cullen, Spokane; Lyman H. Bennett, Jr., Bozeman, with capital of $300,000. The new company reportedly will develop the Easton-Pacific group of 19 patented and 6 unpatented claims, which are situated several miles from Virginia City and which have produced gold and silver ore in the past.

NEVADA

★**Kennametal Inc.** is empoying 96 men at its Leonard mine northeast of Hawthorne turning out 90 tons of scheelite ore and five tons of waste daily. The ore is being treated in the mill which has a capacity of 150 tons. Square sets are being placed in the mine and general development work is being carried on. A ball mill and table flotation are being used to recover the ore. E. M. Colwell, of Hawthorne, is general superintendent of the operations.

★**Basic Refractories Co.** has 140 men on its payroll at the company's magnesite plant in Gabbs. Surface mining operations keep 34 men busy turning out 370 tons of ore and 600 tons of waste material daily. The company is stripping in the open pit mine, and preparing roads to strategic parts of the property. The mill employs 38 men. Pat Willard is works manager for the company, F. W. Menzl is mill superintendent, and A. M. Dixon mine superintendent.

★**Lewis C. Mehan,** of Redwood City, Calif., and W. W. Whitaker, of Fallon, are placer mining 1,200 acres of the Eureka Hamburg Mining Co. property in the Leonard Creek area northwest of Winnemucca. The washer is handling 100 yd. of material per hour. A 400-gal.-per-min. water supply is available, and the operators have a dragline, bulldozer, carry-all, and other equipment on the site. Gold is the principal object of recovery, but nominal amounts of silver also are being found.

★**Development** of the Stokes Iron Mine in northwestern Nye County has been undertaken by the Standard Slag Co. Six men are at work on the open pit operation and have been excavating 800 yards of material daily in stripping process. R. O. Jones, of Gabbs, is general manager.

★**Gabbs Exploration Co.** has 14 men working underground at the Victory Tungsten mine in Nye County producing 60 tons of scheelite ore daily by the shrinkage method. A shaft is being sunk on the property at the same time ore is being produced. L. D. Dougan is president and general manager, Bert Van Voorhis is superintendent, and Jim Corlett is foreman of the work. The company's rod mill and table concentration plant are operating three shifts daily.

★**Commodore mine** in Nye County is now being leased and operated by the Inca Development Corp. which has seven men at work producing 20 tons of ore daily through shaft mining operations. The company also is developing the property by drifting. The ore is treated in the El Capital

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Nevada (*Continued*)

mill which has a capacity of ten tons daily. R. H. Harris is superintendent of both mining and milling, and J. L. Sloane is foreman of the mine. Martin Chiatovich has charge of the milling operations, which employ the concentration method of ore treatment.

★**Manganese, Inc.**, near Henderson, reported July 4 that a new mishap had caused the shutting down of its reduction plant. A fire in the mill destroyed the grinding and flotation facilities. Southeastern Enginering was called in to repair the damage. Only last February, production was interrupted when a large nodulizing kiln broke. Repairs were not completed until May 15.

★**Full production** will begin Aug. 15 at a titanium plant in Henderson, to be operated by Titanium Metals Corp. of America, subsidiary of National Lead Co. and Allegheny-Ludlum.

Capacity of the plant will be 3,600 tons a year, according to G. W. Llewellyn, project manager for the H. K. Ferguson Co., which converted it from a magnesium plant, its World War II use. Llewellyn said the plant's current employment of 600 will be boosted in the future to 1,000.

★A **10-year** dredging lease for the Hells Canyon area of Snake River has been granted to Verner Allen, vice president of Yale Mining Co., which operates lead and zinc mines in British Columbia.

To obtain the lease Allen had to obtain the approval of two states—Oregon and Idaho—because the Snake forms the boundary between them in the Hells Canyon area.

S. K. Atkinson, Boise, Idaho, obtained a dredging lease for the same territory last year. Later he requested that it be transferred to Allen, who is from San Francisco.

Atkinson estimates $171-million in gold, monazite and other rare metals can be obtained from the Snake River bed. He announced in San Francisco that he has started test drilling. He estimates the tests will last six months and will cost $50,000.

★**Standard Slag Co.**, also producing magnesite in the Gabbs area, is operating the Greenstone Addition Mine. The company has 69 men at work at the mill, open pit mine, shops and office. The mill is running three shifts daily, while the mine operates one shift. R. O. Jones is manager, S. V. Wines is mill superintendent, and F. W. Reinmiller is mine superintendent.

NEW MEXICO

★**Counsel for** W. A. Greer of Continental Divide has asked the state District Court, for a writ of mandamus to force State Land Commissioner E. S. Walker to issue uranium mining leases covering 20,000 acres of state-owned land. The action followed a hearing July 9 in Albuquerque that was inconclusive.

Hearing in the original suit was on a state motion to dismiss the complaint on grounds that Greer's action was improperly brought and that the court could not rule on a matter discretionary with the land commissioner.

Greer obtained exploration permits on the land in 1951. He received a one-year extension in March, 1952. Just before the extension expired in March this year, Greer filed application for placer mining permits on the entire acreage. The land commissioner refused to issue placed permits, ruling that uranium mining would have to be done under more expensive lode permits. Placer leases on the property Greer filed on would run about $1,000; permits would cost close to $20,000.

During the hearing, Anthony Albert, state Land Office attorney, charged that he had reason to believe Greer had not complied with a Land Office regulation which requires that work be done on the acreage before leases can be issued. Greer's attorney said under the rules, Greer was entitled to the leases.

When Greer's leases were held up, a flood of applications by other parties to work the disputed acreage was

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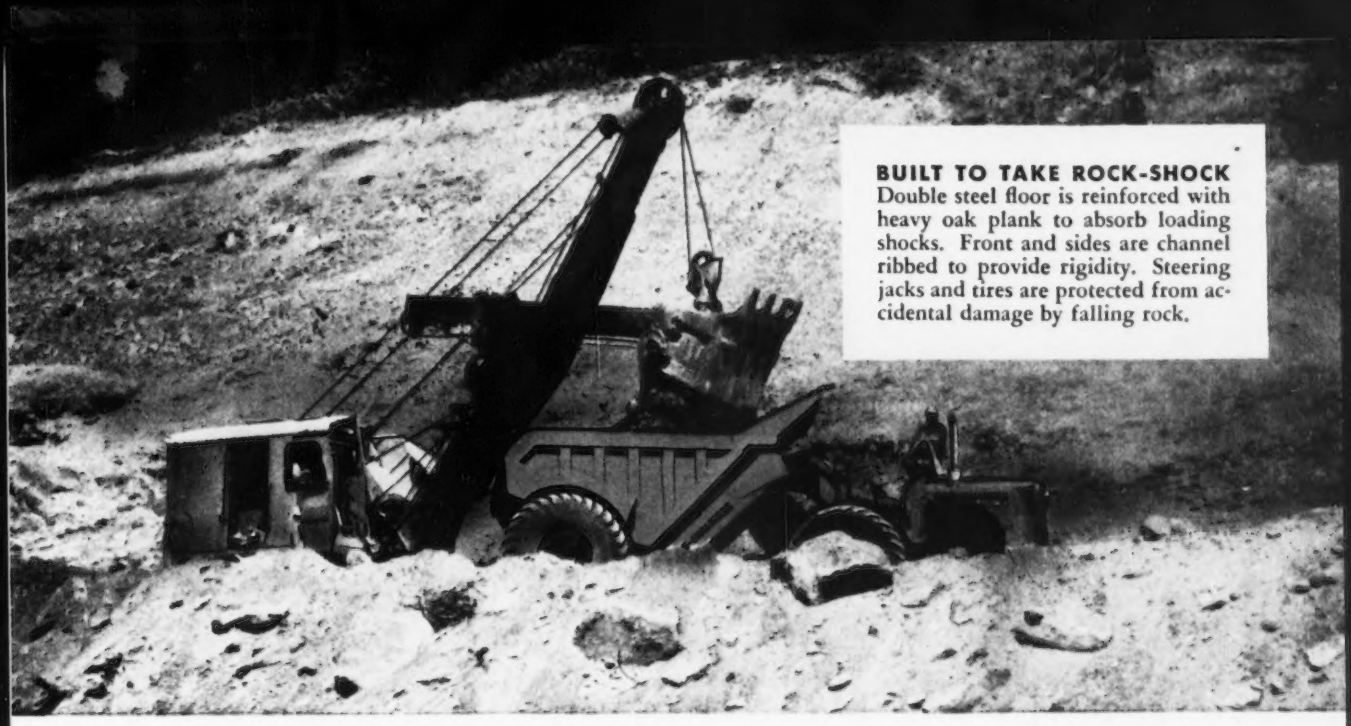

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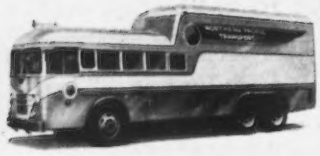

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New Mexico *(Continued)*

filed with the Land Office. These applications are being held by the Land Office without action until the litigation is settled.

In May, Land Commissioner Walker offered to validate Greer's holdings if he would amend his application to seek lode leases instead of placer leases. After the hearing, Lorenzo Chavez, attorney for Greer, said his client would now readily pay $20,000 for lode leases except for the possibilty that he would be sued by the other persons who filed on the disputed acreage in April.

The Greer litigation has delayed issuance of uranium mining permits on all state-owned land, though prospecting is in progress over a wide area of northwest New Mexico.

The Land Office has issued placer prospecting permits for uranium, in spite of the fact that it intends to require lode permits when mining leases are issued. Placer prospecting permits, under state law, give the operator a year to develop his acreage. Lode prospecting permits give only 90 days for exploration and development.

The Land Office intends to require that uranium claims be relocated in 20.66 acre tracts. Lode claim leases will then be issued at a cost of $25 per claim per year. State's royalty on production will be 5% after deduction of treatment and transportation costs.

★**Tungsten Consolidated,** a new firm, is producing columbite from a mine at Petaca, Rio Arriba County, in northern New Mexico. It was reported that the firm began operations in June and shipped 3,040 lbs. of ore in June. Ore is shipped to Kennametal, Inc., at Latrobe, Pa., for refining.

Mining is a strip operation. Output is hauled two mi. to a small mill in the valley near Petaca. Stuff is washed and ore separated in a jig.

★**AEC has announced** intent to begin a core-drilling program, exploring for uranium, on 2,280 acres of state-owned land in McKinley County near Grants. Tract is the first state-owned land in New Mexico to be explored by the AEC.

Land to be covered in the exploration program is currently the subject of litigation over lease rights which has resulted in a temporary freeze on mining leases on uranium-bearing state-owned lands.

★**Close to 400 coal miners** will be out of work in Colfax County as the result of a "major curtailment" of coal operations here announced at the end of July by St. Louis, Rocky Mountain and Pacific Co. J. R. Kastler, company vice president, said the curtailment is due to lack of orders.

The company shut down its Brilliant pit, where nearly 40 miners were employed. Its Van Hooten mine, where 50 were employed, is being cut

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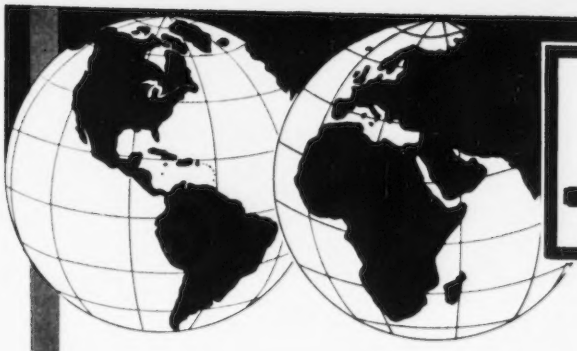

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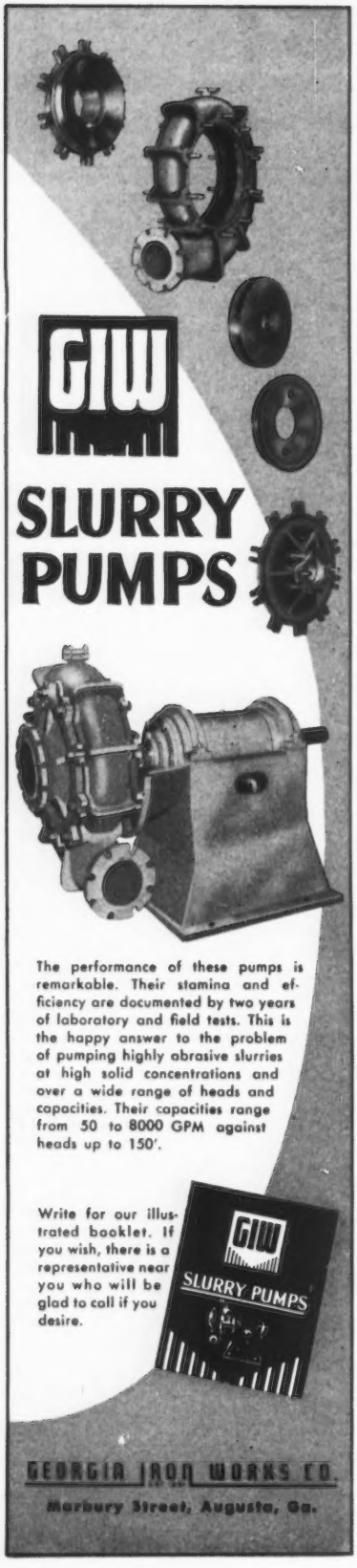
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New Mexico *(Continued)*

back 10 to 12%. And an 80% cutback is in prospect at the big Koehler workings where 400 were employed. Miners kept on at Koehler, however, will work a five-day week instead of two or three days they have been working.

NORTH CAROLINA

★**Minerals Resources Committee** of the North Carolina State Board of Conservation and Development on July 28 requested Conservation Director Ben E. Douglas, Attorney General Harry McMullan, State Geologist J. L. Stuckey and representatives of the National Park Service to draw up the necessary contract for the construction of a minerals museum on the Blue Ridge Parkway in western North Carolina and to submit it to the board at its next meeting.

Governor William B. Umstead and the Council of State last month made available $75,000 for the building and museum, and the National Park Service has agreed to provide maintenance for the museum, which will be located at Gillespie Gap, near Spruce Pine. The museum contract is expected to be submitted to the board within the next 30 days.

OREGON

★**Production of gold** in the state during 1952, according to an estimate released by the U. S. Bureau of Mines, Albany, Oregon, totaled 5,509 fine oz., valued at $192,815. This was considerably less than any annual production reported except during 1943 and 1944 when gold mining was halted by the WPB Order L-208. Powder River Dredging Co. which operated in Sumpter Valley, Baker County, accounted for 83% of the 1952 production. Most of the gold in the state in recent years has come from placer mining, especially dredging. The Powder River company is the only gold-dredging operation left. Of the 1952 total, 9% came from two lode mines, the Buffalo near Granite in Grant County, and the Champion, in the Bohemia district of Lane County.

★**Shipments of chrome** to the Grants Pass Purchasing Depot this summer have been almost 2½ times larger than in the same period of 1952.

★**Eggers and Tycer,** O'Brien, have purchased the chromite mill at French Flat, near Takilma. Eggers and Tycer are rehabilitating the old Chollard mine and have enlarged the glory hole. Chrome ore is being hauled from the Chollard to the mill where a jaw crusher has been installed.

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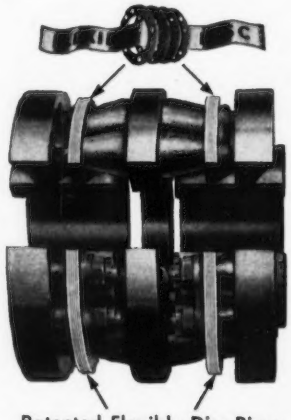

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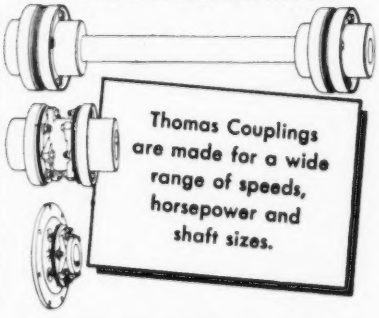

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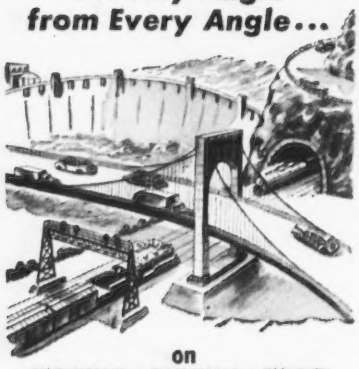

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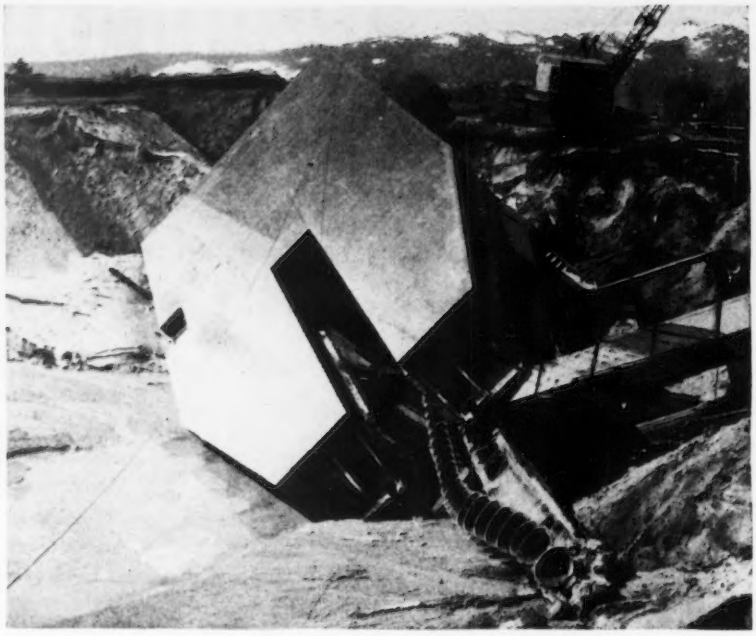

WARREN DREDGING CORP. workings near Cascade, Idaho, were interrupted when a 400-ton Marion dredge toppled over after a leak in a sand pump flooded a stern pontoon. Ten minutes after the winchman and oiler abandoned the sinking 4-cu. yd. monazite dredge, it overturned with a crash that reduced the boat to matchwood. Photograph shows bottom and bucket line. It was taken after the 33-ft. pond had been drained.

Oregon *(Continued)*

pany's electric bucketline dredge is under way. It had operated for years in the Granite area of Grant County and later on Crane Creek.

UTAH

★**Two additional land areas** in Utah have been separated from the public domain for use in the Atomic Energy Commission's program of uranium exploration. The lands affected are in the Elk Ridge area, San Juan County.

★**Minerals Refining Co.,** with laboratories in the former A S & R smelter at Murray, has been licensed by the Atomic Energy Commission to deal in the reduction of uranium and thorium, and also is separating monazite and other rare earths, according to Paul Cardon, chemist and president of the concern.

Much of the company's work is being carried out in conjunction with the Mallinckrodt Chemical Works, St. Louis.

Minerals Refining Co. is utilizing a magnetic separator to process monazite, chiefly from the Boise Basin region of Idaho. The concentrate is separated further through use of an ion exchange process.

★**E. G. Frawley,** president, Consolidated Uranium Co. (Felt Bldg., Salt Lake City), has reported indications of a "substantial tonnage" of ore in the company's principal properties in the Temple Mountain region of Emery County, as a result of recent exploration work.

★**Diamond Trails Mines,** Marysvale, will conduct a 3,000-ft. diamond core drilling program, John W. Wilhelm, company president, has reported.

Company equipment will be operated in an area where Dr. Paul F. Kerr, Columbia University, found uranium minerals in 1952, Wilhelm stated. A contract has been let for drilling a 12-in. ventilation hole at a point 4,650 ft. within the company tunnel.

★**W. H. H. Cranmer,** president, New Park Mining Co., Salt Lake City, has announced acquisition of some 3,500 acres of leases from claim owners in the booming southeastern Utah region near the Big Indian Canyon uranium discovery claims of Geologist Charles Steen.

New outfits working in the area include such investigators as Harlan Walker, Salt Lake City, retired assistant general manager of the Homestake Mining Co. and a prospecting outfit backed by officials of Helena Rubenstein Co., a cosmetics firm.

★**Tungsten mines,** many of them small, are reported expanding their operations in Utah, with the establishment of a new refinery—the Salt Lake Tungsten Co.

Schedules released in Salt Lake City indicated some profits could be

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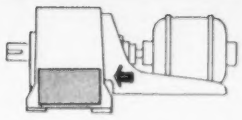
Any make, speed, or type of standard foot-mounted motor within the unit's AGMA rating is usable *without modification* on this All-Motor type Motoreducer. Motors with variable speed drive arrangement can be used, if desired. No "partial" motor or special shaft is required in event of motor replacement—simply use a complete motor, available for quick delivery from factory or local stocks without expensive delays.

Add to these exclusive maintenance-saving advantages the FALK "In-built" Factors, described at the right, and you have an unbeatable combination of quality, application adaptability, dependability, long-range economy, and dollar-for-dollar value. Write for Bulletin 3104.



Every FALK Motoreducer has these "In-built" Factors—

Positive Lubrication. Large sump capacity . . . oil-tight construction assures clean lubricant . . . direct dip of revolving elements provides positive lubrication at all speeds.

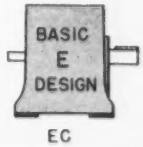
Wide Speed Range. Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

Streamlined inside and outside. Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

Sealed Housings. Dual closures and one-way vents keep oil *in,* dust and moisture *out.* Units are splash-proof, leakproof, dustproof.

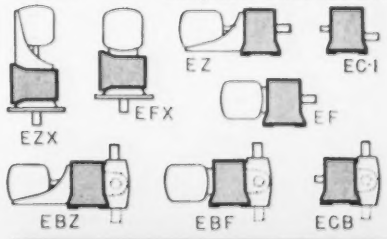
Precision Gearing. Heat treated alloy steel, precision cut and shaved helical gearing throughout . . . quiet-operating crown shaved pinions . . . taper bored gears for easy ratio changes.

All-steel Housings. Unbreakable, strong, rigid. Generous overhung load capacities provided by wide bearing spans, large shafts and bearings.



EC

The basic E design permits maximum use of standardized parts . . . closer control over materials, processing, inspection and assembly . . . resulting in faster delivery from interchangeable stocked assemblies.



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WRITE FOR BULLETIN 3104

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Turn to a CLEVELAND air vibrator. It's surprising the variety of materials it will move through your bins, hoppers, chutes and other handling devices. Economical and efficient to use for *anything* . . . steel chips, sand, gravel, ore, chemicals, concrete, coal . . . inclined to arch, bridge or stick.

Standard metallic impact and air-cushioned, quiet types in 29 different mountings.

COMPLETE LITERATURE ON REQUEST.

THE CLEVELAND VIBRATOR COMPANY

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Utah *(Continued)*

made by individuals or partnerships producing western tungsten ores running 0.5 to 0.6% in values, while company-sized operations were bringing fair returns from 1% ores.

★**In one of** the first reopenings in the old Tintic District of Utah for several decades, the Mammoth Mining Co. began working on its properties after a shutdown of nearly 10 years.

Steele McIntyre, of Pioche, Nev., engineer for Combined Metals Reduction Co., was named manager for the development.

Some 20 miners are to be employed as the property goes into production.

Gold, silver, lead and copper ores from the old district will be shipped to the Garfield smelter of the American Smelting and Refining Co. for use as a fluxing material.

★**Chief Consolidated Mining Co.** will spend $1,133,492 in development work at the Chief No. 1 mine in the Eureka district during the coming three years, officials announced in Salt Lake City. The fund includes $283,373 of government money, one of the last DMPA programs approved for a lead-zinc operation by the federal agency.

Some 22,000 ft. of drifting and cross-cutting, and 40,000 ft. of diamond drilling are included in eight projects comprising the overall plan for Chief No. 1 developments.

The diamond drilling program will be carried out in connection with the location of ore bodies by drifting, and does not represent an all-out exploratory drilling program, it was made clear.

Chief Consolidated officials stressed that the program is basically dependent upon revival of lead-zinc prices and stability of the industry. Work on the program is already under way, but would be suspended if economic conditions become more unfavorable.

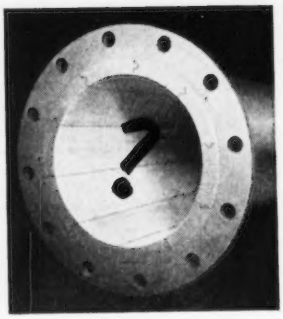
The major portion of the work is planned in two projects at the north end of the Chief No. 1 on and below the 2,700-ft. level. This includes development of ore bodies that may extend to the 3,100-ft. level.

In recent years changes in ore haulage at the mine have included a new high-speed hoist and pumps capable of moving 14,000 gal. of water per minute.

WASHINGTON

★**Production records** were broken during the first six months of 1953 by the Kaiser Aluminum & Chemical Corp. at its Mead and Trentwood plants near Spokane. The combined output for the period was 323,845,000 lb. of primary and rolled aluminum, an increase of 22% over the same period in 1952. Increased production reflected the addition of an 8th pot line at the Mead reduction plant in July, 1952, and a 50% increase in the

what do you expect of ? mine pipe



- ✓ corrosion resistance
- ✓ abrasion resistance
- ✓ strength
- ✓ light weight
- ✓ low friction loss
- ✓ high pressure rating

(Up to 400 p.s.i. or higher for special applications)

If you expect the mine pipe you buy to answer these needs . . . and more . . . YOU WANT MPC WOOD-LINED STEEL PIPE!

Typical installations of MPC Wood-Lined Steel Pipe are now successfully handling 25% silica slurries (16 f.p.s. @ 150 p.s.i.) with the expected advantages of economy and dependability. Keep these advantages in mind for your next purchase of mine pipe!

Wood-lined fittings in standard and special designs for all diameters. For catalog and additional information, write Dept. EMJ.

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Advantages of Philadelphia Worm Gear Reducers

To insure long, dependable service from Philadelphia Worm Reducers, the greatest care and research goes into the selection of materials for the worms and worm gears. The predominant sliding action dictates the use of dissimilar metals to minimize frictional wear.

Philadelphia Worms are of alloy steel with hardened threads. Shaft and threads are smoothly ground and polished after hardening. The result is increased gear life through improved surface finish.

Worm Gears are of high quality chill cast nickel bronze to provide greatest strength, with a low coefficient of friction against the worm.

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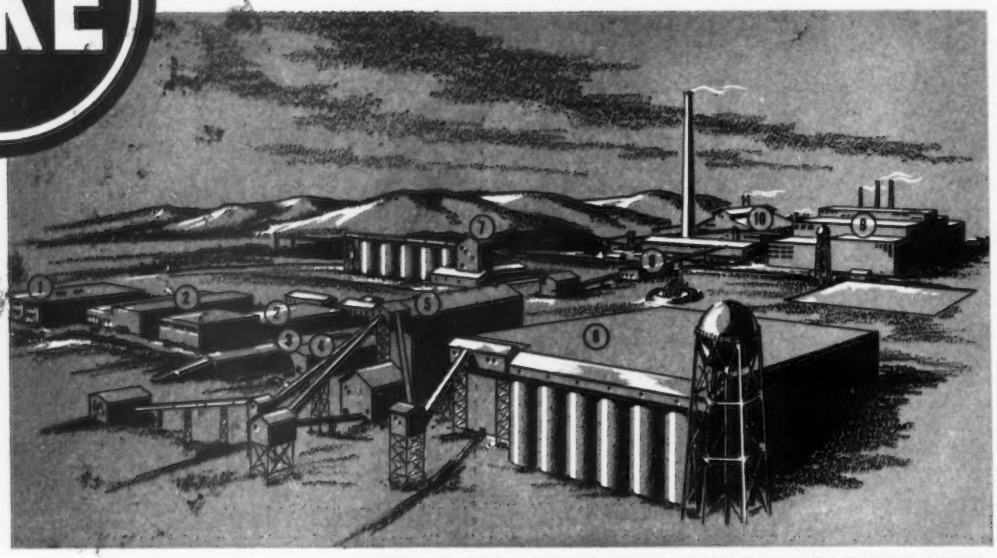
WKE Progress Report



ARTIST'S RENDITION OF WHITE PINE COPPER COMPANY INSTALLATION, WHITE PINE, MICHIGAN

White Pine Copper Project

75 million pounds of copper per year! That is the production expected from the new White Pine Copper Co. plant at White Pine, Michigan. This project represents a vital addition to the economic and industrial strength of America. To perform the design work for all mine, mill and smelter facilities, this important copper producer chose Western Knapp Engineering Company, a division of Western Machinery Company.

The following statistics — covering production facilities only — illustrate the tremendous scope of this project and convey some idea of the extensive design work for which WKE was responsible.

EXCAVATION	550,000 cubic yards
CONCRETE	44,000 cubic yards
REINFORCING STEEL	2,300 tons
STRUCTURAL STEEL	13,500 tons
CONNECTED HORSEPOWER	50,000
CRUSHING PLANT	14,280 sq. ft. floor space
CONCENTRATOR BUILDING	134,652 sq. ft. floor space
FILTER BUILDING	5,760 sq. ft. floor space
FLUX CRUSHING PLANT	4,840 sq. ft. floor space
SMELTER BEDDING PLANT	15,400 sq. ft. floor space
SMELTER BUILDING	52,800 sq. ft. floor space

These figures represent one more job well on its way to completion by WKE's top-flight design and engineering staff. Whether your job is large or small, a call on WKE puts at your disposal an experienced organization with competent personnel who know how to get the job done better and faster. And remember, too, that WKE is geared to handle a project in the way that best meets your needs. Metallurgical studies, engineering surveys, plant design, construction and initial plant operation — for all or any combination of these functions, you can rely on WKE.

Write today for information on your particular problem.

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WESTERN KNAPP ENGINEERING CO.
DIVISION OF WESTERN MACHINERY COMPANY
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Washington (*Continued*)

production rate at the Trentwood rolling mill.

During the first half of the year the Mead reduction plant's output was 148,512,000 lb. of pig aluminum, while the Trentwood plant fabricated 175,333,000 lbs. of aluminum.

The 4,500 workers at Kaiser's Mead reduction plant and the Trentwood rolling mill were included in the 6,000 workers who were affected when an announcement of an 8½¢ hourly wage boost was made jointly in Oakland, Calif., by Kaiser Aluminum & Chemical Corp. and CIO United Steelworkers of America. The increase became effective July 13. In the Spokane area the weekly industrial pay roll was boosted about $15,000. Also affected by the order was the Kaiser plant at Tacoma.

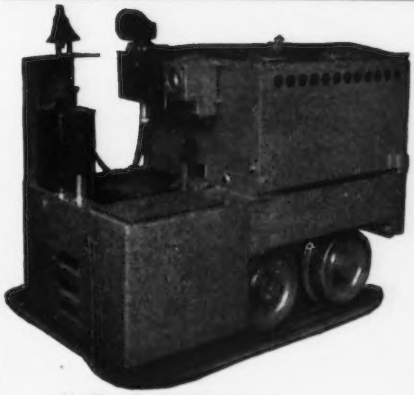
★**Aluminum Company of America** signed an agreement July 16 for an 8½¢ hourly increase in wages for 1,100 workers at its plant at Vancouver. The contract was with AFL Aluminum Trades Council and provided 4¢ hourly wage increases effective July 1, and 4½¢ effective July 13.

★**About 25 tons** of ore is being broken daily at Germania Consolidated Mines, Inc., tungsten property in Stevens County and a shipment was to be made. Production is in high-grade jig tailings. A lower grade product is being sent for upgrading to the Big It Mining & Milling Co.

★**Pacific Northwest Alloys Inc.** will continue to produce ferrosilicon from two electric furnaces at its Mead plant, an official reported. Ferrochrome production was scheduled to begin in July. Current pay roll of 240 to 250 includes about 195 operating employees. The company had been producing magnesium and ferrosilicon for the Government but the agreement was terminated. The alloys company then leased the plant intending to convert to ferrochrome but has now decided to continue the production of ferrosilicon, too.

★**Washington Non-Metallics Inc.** has installed new equipment at its plant at Chewelah which will more than triple its output of marble products. It will be possible now to produce 150 tons daily. A 40 x 100 ft. warehouse is being built around the mill without interrupting the work in the crushing and screening plant. New uses for the products have caused a greater demand from builders.

★**Chewelah Copper Co.** which owns or controls United Copper, Copper King and Copper Queen properties at Eagle Mountain copper camp near Chewelah, has acquired the Amazon and Independence Keystone groups of mining claims. Chewelah expected to start shipping copper-silver ore early in August from its Eagle Mountain area properties. The ore to be shipped will come from an adit



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Use the coupon or write for Bulletin 25.

REMEMBER, Acker also makes a complete line of Diamond and Shot Core Drills, Drilling accessories and equipment.

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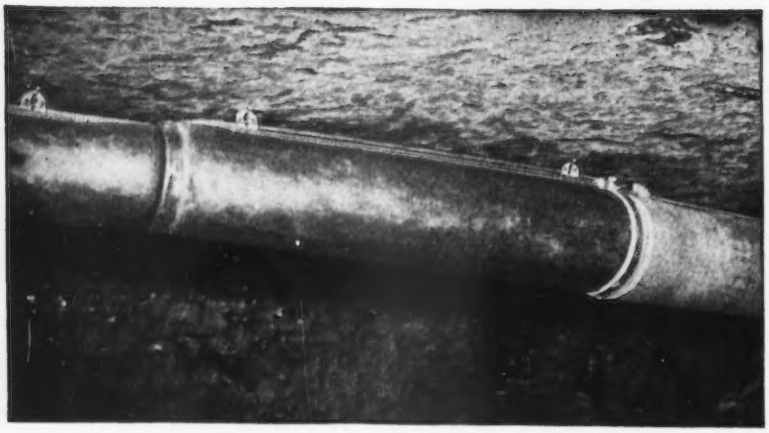

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Flexipipe is efficient, serviceable, economical. Jute and heavy-duty grades available in a variety of lengths and diameters to meet your requirements.

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GREENSBURG MACHINE COMPANY

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Washington *(Continued)*

in the Copper King and the 400-ft. level of the United Copper. A bunker is being completed, air lines are being laid and regular shipments are expected to come soon from the five known veins of the Copper King.

★**Reeves-MacDonald Mines Ltd.,** Canadian subsidiary of Pend Oreille Mines & Metals Co. of the Metaline district, has closed down operations at its mine in southeastern British Columbia. Only a maintenance crew is kept at the mine. Negotiations on contracts between the Reeves company and the International Union of Mine, Mill & Smelter Workers are still in progress. It was reported that union negotiators and the majority of the provincial conciliation board have recommended that the 1952 contract continue unchanged. The Reeves company has asked for a reduction of about $2 per day in all pay rates and elimination of some fringe benefits.

★**Pioneer Mining Co.** of Colville with property in the Old Dominion district of Stevens County, northeast of Colville, has opened a new ore shoot in the Longshot mine. The new shoot is said to be 10½ ft. wide and 25 ft. long.

★**Sunshine Mining Co.** has reported increased earnings in the second quarter ending June 30 over the first quarter this year. Sunshine's earnings increased 23% in the second quarter. Smelter returns amounted to $966,534 in the second quarter, and $783,796 in the first. But for the first six months of this year, Sunshine net earnings are slightly lower than 1952.

★**Two major** mining companies in the Coeur d'Alene district believe natural gas will permit cheaper operation.

The Bunker Hill lead smelter and the Sullivan Mining Co. zinc plant, both at Kellogg, Idaho, could operate more cheaply with natural gas, according to briefs submitted to Spokane County commissioners. The commissioners were studying an application by Trans-Northwest Gas Inc., for a franchise to serve the Spokane valley and Coeur d'Alene mining district with natural gas.

(Applications by three firms for interstate pipelines for natural gas are before the Federal Power Commission in Washington, D. C. Trans-Northwest corporation would not produce gas but purchase it for distribution.)

Both Bunker Hill and Sullivan now use oil for their plants. Neither firm could estimate savings in fuel costs until the natural gas rate is determined but declared that "many thousands of dollars" apparently would be saved, based on expected gas costs.

The briefs stated: "In view of the fact that present market prices are 3¢ a lb. less for lead, and 5¢ a lb. for zinc, than the average prices received in 1952, and that present low prices

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BIG RED CHAMP rams into a heavy load of rock and dirt overburden, pushes it along with power to spare.

Strip Miner Gets Out Five Times as Much Coal with Two Big Red Champs.

It's no cinch to strip mine where the overburden is 32 feet deep. It takes some blasting—and two International TD-24s—to gouge out 80 tons of coal a day for Charles Walls & Sons, Oliver Springs, Tennessee.

The way Mr. Walls tells it,

"We got into big time coal stripping when we put these fast powerful TD-24s to work. We soon found our production of coal about five times what it used to be, yet our labor in the mine was the same as it was before."

The Big Red Champ—International's TD-24—does jobs like this because it delivers 148 drawbar horsepower, 8 speeds forward or reverse to 7.8 mph, and has Planet Power hydraulic steering controls. All this makes the TD-24 faster, easier to maneuver, able to do more work than any other crawler on the market.

See for yourself. Ask your International Industrial Distributor to show you what Big Red can do for you. You'll be a TD-24 man from then on in.

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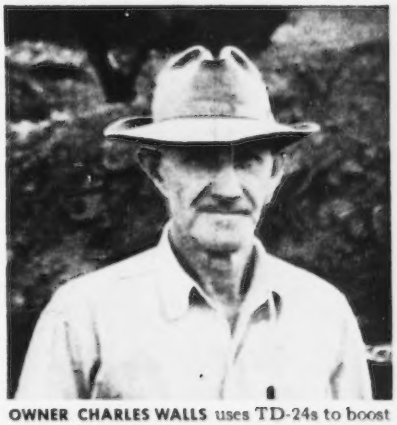

OWNER CHARLES WALLS uses TD-24s to boost his production five times with same labor.

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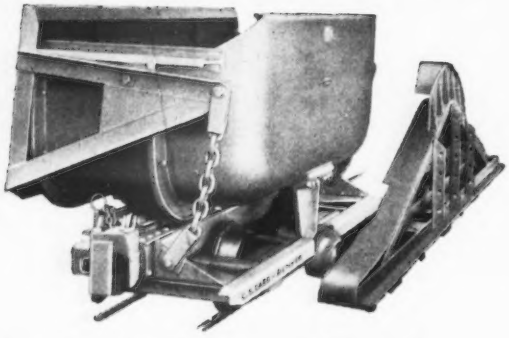
Lower Mine Haulage Costs

are in the

CARDS



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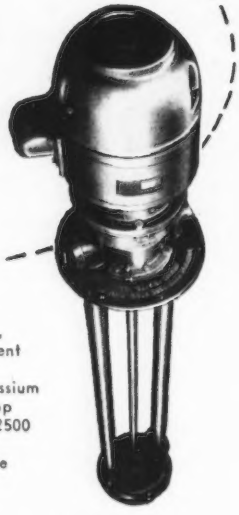

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can be expected to continue for an indefinite period, such economy as can be made through the use of gas is of special importance to us."

The Spokane County commisioners granted Trans-Northwest Gas its franchise, and granted a similar franchise to a competitor, Spokane Gas & Fuel Co.

★**Electric Point** lead mine at Colville, Wash., now being rehabilitated after once having been one of the state's highest grade producers, has been willed to the Shriners' Hospital for Crippled Children in Spokane, by the late Mrs. Maude Simonton.

Now under lease and option to the State Mining Co., the property turned out about 100 tons of ore daily from 1916 to 1920. Mrs. Simonton was sole owner.

★**United States Gypsum Co.** advised approximately 60 employees at its plant near Evans, Wash., this week that the plant will not reopen. The plant has been shut only once in 53 years, when fire damaged equipment in the thirties. But since April 7 this year, employees have been on strike.

Negotiating sessions between U. S. Gypsum and the steelworkers union have failed to settle the dispute. In its letter announcing permanent closure of the lime plant, the company said it has been operating without adequate return in recent years, and industrial users who are the principal customers of the Evans plant are demanding a better quality product. The cost of careful selection and separation of materials has increased the cost of running the Evans plant.

★**Kaiser Gypsum Co.** is to construct a gypsum board plant and plaster mill at Seattle in a few months which will cost about $4-million. Annual capacity of the gypsum plant will be 10,000,000 sq. ft. of gypsum board products. About 170 persons will be employed in the plant. A 9½-acre site has been purchased on East Marginal Way with access to Duwamish waterway. Ore will come from the company's quarries on San Marcos Island in the Gulf of California.

IN CANADA

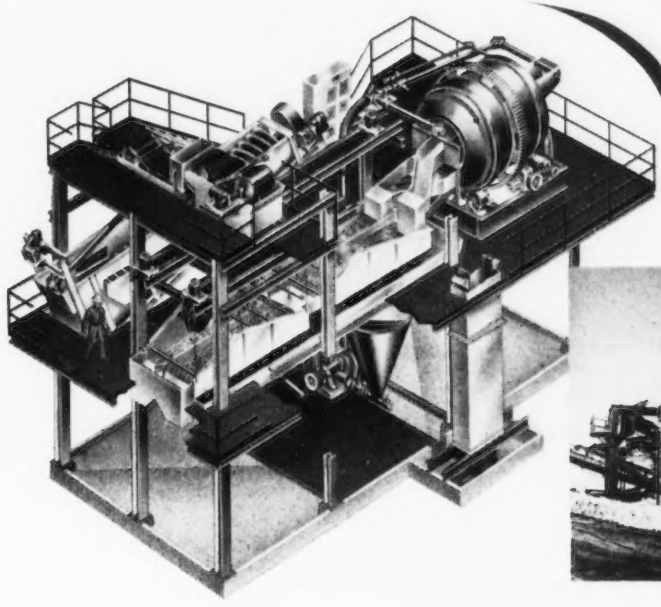
LABRADOR

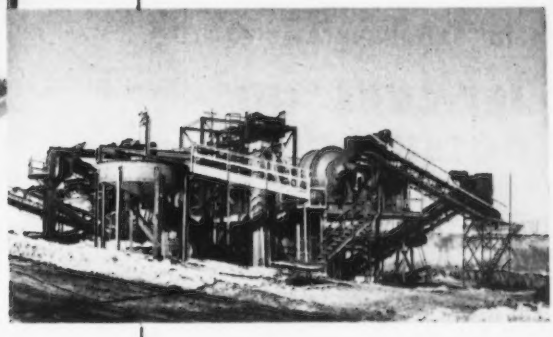
★**Canadian Javelin Foundries & Machine Works Ltd.**, Montreal, has been granted a concession of 1,472,000 acres in southwest Labrador. This acreage is in 3,056,000 acres of a mineral concession in that area held by the Newfoundland & Labrador Corp. Ltd.

The Newfoundland & Labrador Corp. is a government-backed mineral and timber development company established by the Newfoundland government in 1951, with the government holding a majority of the stock. It has 16-million acres of mineral rights

WEMCO MOBIL-MILLS

are built to your exact needs





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- **as complete production plants** for economic extraction of the valuable mineral from ore.
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- **as pilot plants** to investigate the feasibility and economy of Heavy-Media Separation.

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Labrador (*Continued*)

in Newfoundland and Labrador and 3.2-million acres of timber rights in Labrador.

In addition to the new concession to Canadian Javelin, the corporation last year granted concessions in its Newfoundland holdings to Newmont Mining Corp. and American Zinc, Lead & Smelting Co. Ltd. Both these firms have exploration parties in the field and reportedly are spending $100,000 between them in mineral exploration.

ONTARIO

★**Calder-Bousquet Gold Mines Ltd.** reportedly has begun diamond drilling on its 600 acre Beaverlodge property adjoining the Rix Athabasca Uranium Mines Ltd. Initial drilling was to be undertaken in the south end of the property along an east-west striking structure believed to be associated with the Bug Lake Fault. A program of line cutting is underway.

★**Falconbridge Nickel Mines** is making steady progress in formulating the plans under which nickel output, and that of copper along with it, will be boosted from 30 to 60-million lbs. annually.

Eventually there will be nine company-owned mines operating in place of the two now producing and there will be three new concentrators. There will also be increased smelter and refinery capacity. The seven new mines will include the Hardy, Fecunis, and East Falconbridge, all of major status, and the Mount Nickel, Longvack, Strathcona, and Boundary. The new concentrators will be at the Hardy mine, 1,500 tons; at Fecunis, 2,000 tons; and in the Strathcona area, 1,200 tons daily. It will be close to 1960 before full expansion is achieved.

★**Steep Rock Iron Mines** is encountering no problems in its expansion program under which iron ore output will be raised to 3.5-million tons per year by 1955. This year will probably see a new record marked up, while 2-million tons looks likely for 1954.

★**Development of Kerr-Addison's** deepest level is producing impressive results. The big Larder Lake gold mine, Canada's biggest producer, is now opening the 3,700-ft. horizon where results to date have shown 5,705 tons per vertical ft. with average grade 0.83 oz. gold per ton. It is unofficially estimated that only about 40% of the level has been developed. The indicated grade is approximately four times that of the mine's average. It will, however, be some time before the new level affects production since mining is still confined to shallower horizons. Mine development is far ahead of production needs. There is a tremendous

(*Continued on page 170*)

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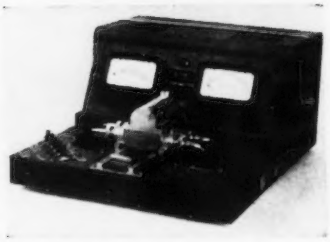

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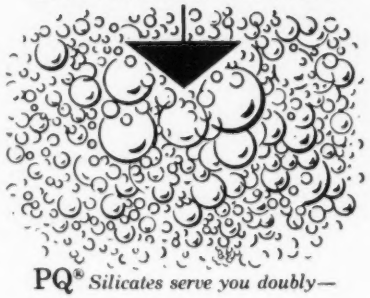

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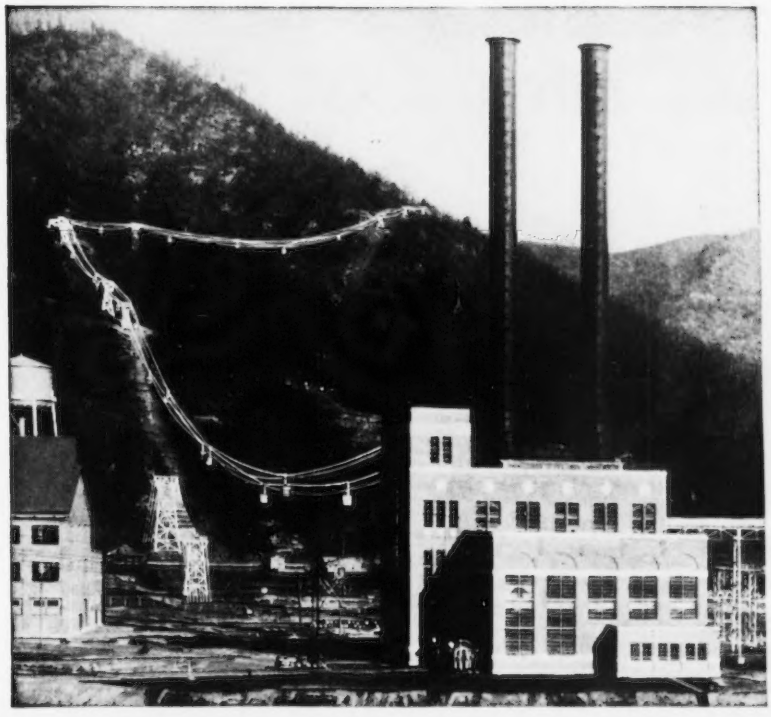
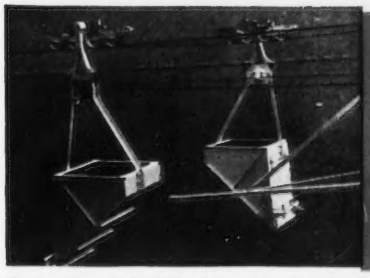


This 8,775 foot bicable tramway has been in continual operation for 23 years, transporting large quantities of coal at low ton-mile cost and giving dependable all-weather service.

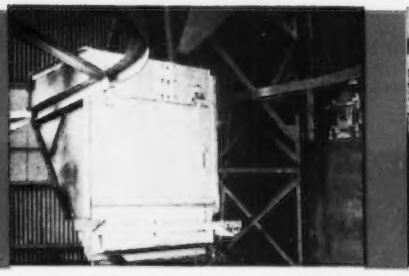
The tramway has two stationary track cables and a traction rope that moves continuously in one direction. Buckets clamp to the moving rope at 205 foot intervals and move at 500 feet per minute.

The 48 cu. ft. end dump buckets load and unload automatically. For loading, buckets detach from traction rope, run on graded rails, and attach again after being loaded. Detaching and attaching are also automatic.

This aerial tramway was designed and installed by the Tramway Division of U. S. Steel at the Alloy, West Virginia, plant of Electro Metallurgical Company, a Division of Union Carbide and Carbon Corporation.



Conveying materials for a few hundred feet or for several miles, Columbia-Geneva Tramways can be built to handle from 1½ to more than 300 tons hourly. They can be designed to meet almost every type of operating condition, and to handle many kinds of commodities easily and economically—from a tray of optical lenses to a carload of lumber.



Load carriers, like this one on a bicable tramway, are available in many different types and sizes. Services of Columbia-Geneva's Tramway Division include designing the tramway...supplying the steel...excavating for foundations and erecting support structures...furnishing and installing all wire rope, cables, and electrical and mechanical parts.

Tramway support structures are of many types, depending on terrain and job. Because of this flexibility, tramways are free of ground contour, roads, railroads, etc., are unhampered by bad weather, and can climb extremely steep grades. Other advantages: loads can be moved without rehandling and rights-of-way are easier to acquire.

Send for this free manual on aerial tramways. Write on your letterhead today to the Tramway Division, Columbia-Geneva Steel, 141 Battery St., San Francisco 6, Calif. Or for an expert study of your transportation needs, ask for the services of a Tramway Engineer. He can show how an aerial tramway would pay off for you, and he can contract for its design and all phases of its construction, including materials.

Tramway Division

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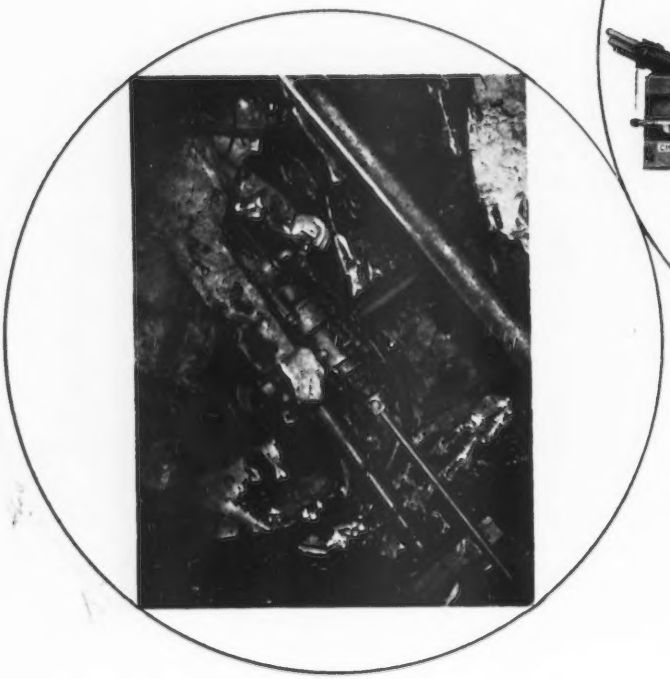

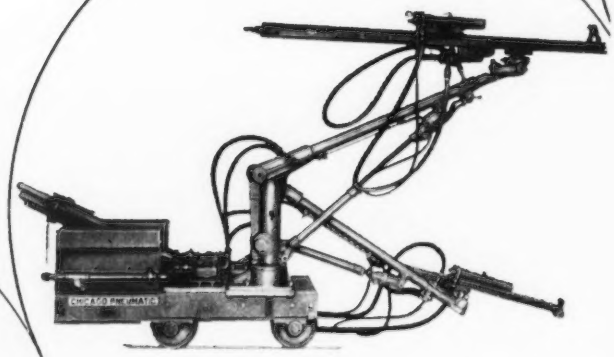

G-600 DRILL JUMBO with two typical drill mountings. The upper arm is equipped with a 6-foot Chain Type Feed; lower arm carries a 4-foot Shell Type Feed.

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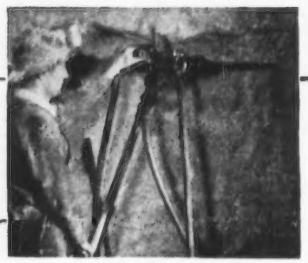

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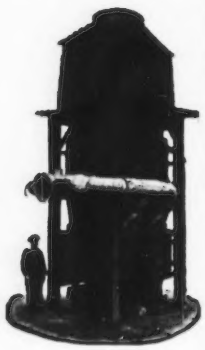

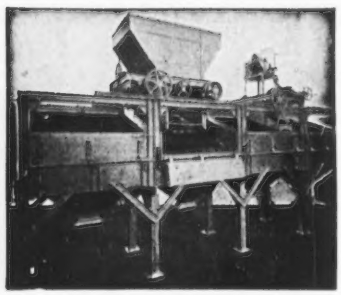

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Ontario *(Continued)*

tonnage of ore in place in the upper levels.

In the first six months of 1953, Kerr-Addison went against the gold mining trend by increasing its profits. Recovery was up from $7.12 to $7.68 so that, although costs increased, net earnings rose.

★**With plans** for a new shaft to 2,000 ft., Algoma Ore Properties Ltd. is going to double the depth of present workings in its Helen mine near Jamestown.

BRITISH COLUMBIA

★**A new uranium rush** started in northern British Columbia following discovery of uranium-bearing pitchblende by Conwest Exploration Co. on the shores of Lake Atlin 20 mi. south of the Yukon-B. C. border. About 350 claims, many of them speculative, have been staked over a strip varying in width from 2½-5 mi. wide and nearly 15 mi. long on the eastern side of Lake Atlin. Conwest has started a road into the most promising area 10 mi. northwest of Atlin and plans diamond drilling to determine the value of the discovery. One sample of uranium has been confirmed.

★**A northern B. C.** copper gamble appears to be paying off for Granby Consolidated Mining, Smelting & Power Co., which has been doing exploration work at the Granduc holdings 25 air mi. northwest of Stewart and 4 mi. east of the Alaska Panhandle. An adit has been driven from the valley floor a distance of 400 ft. of the projected length of 1,250 ft. Four large mineralized zones have been found on the surface, and present work is concentrated on the 2A zone. In the first lateral hole drilled from the tunnel an intersection of 40 ft. assayed 1.4% copper with one intermediate section of 16 ft. carrying 2.2%. The second lateral hole, driven in the same direction from a station 65 ft. to the north cut 36 ft. of ore assaying 2.3% copper. The same zone had previously been explored by a hole driven from the surface at a point 75 ft. to the north of the second underground hole and had shown a core width of 25 ft. grading 4% copper.

★**B. C.'s first asbestos mine** moved into production July 2 when Cassiar Asbestos Corp., Conwest Exploration subsidiary, began operation of its mill in the McDame Creek area. Cassiar hopes production will hit 250 tons daily in the near future. Reserves are estimated at 290,000 tons.

★**Consolidated Mining & Smelting Co.** and its 6,000 employees at Trail and Kimberley have agreed to contract recommendations of a conciliation board which provides for no wage increase this year. Originally the

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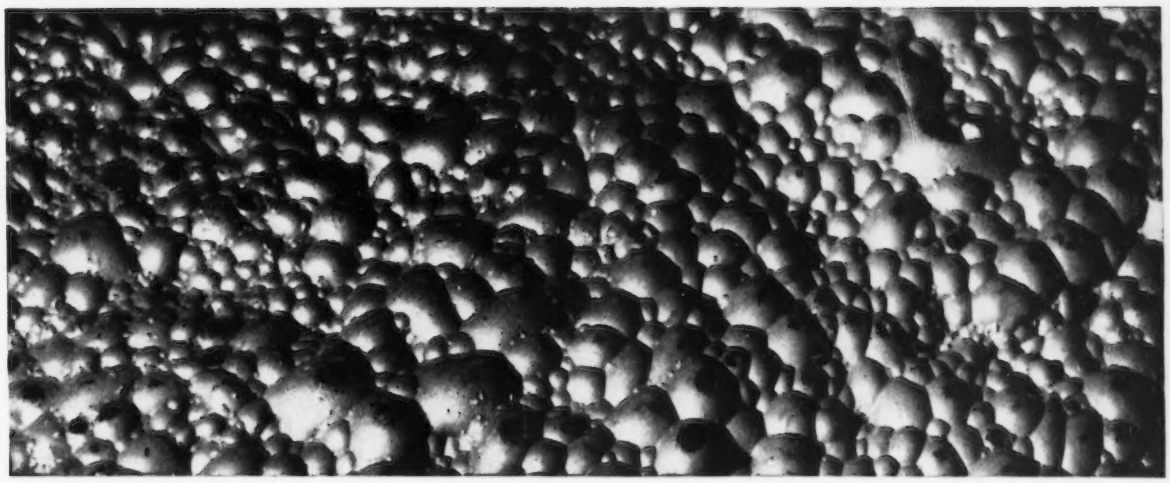

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British Columbia *(Continued)*

workers, members of International Union of Mine, Mill and Smelter Workers, had asked for a 20¢ hourly pay boost. The company had asked for a 10¢ wage cut. Employees of Cominco's hydrogen plant at Trail set an all-time record July 12 by completing 1,250,000 man-hours of work without a lost-time accident.

★**Problem of separation** of tungsten from other materials in its ore on Selkirk Mountain, 20 mi. east of Revelstoke, has been solved by Columbia Lead & Zinc Mines, which expects to be treating 100 tons daily in its 200-ton mill. The operation can also handle lead-zinc ore if warranted. In flotation test work on table concentrates at the mill, G. S. Eldridge & Co. Ltd., metallurgists of Vancouver, upgraded the table concentrate from 15.4% tungsten oxide to 68.8% with 1.6% sulphur, resulting in a product which can be readily cleaned down to 0.3% in cleaner cells.

★**Western Tungsten Copper Mines Ltd.** has boosted milling rate at its Red Rose mine to more than 140 tons daily compared with an average last year of 57 tons, and proved tonnage now stands at 123,000 tons, compared with 105,000 tons in March. W. N. Taylor, Red Rose general superintendent, has been appointed general manager, replacing R. S. Douglas, who has resigned to open his own firm and will continue as consulting engineer for Western Tungsten.

★**Silver Tip Gold Mines Ltd.** will reopen its silver-lead property near Stewart despite closure of the Silbak-Premier mill, which was to have handled Silver Tip ore when the mine started shipping later this year. Silver Tip now will concentrate on building up reserves for larger-scale shipping.

★**Reeves-MacDonald Mines Ltd.**, has shut down operations at its mine in southeastern British Columbia, just across the international border from Metaline district of Washington. The firm is a subsidiary of Pend Oreille Mines & Metals Co. Manager W. L. Zeigler said only a maintenance staff is on duty.

★**First gondola car** of phosphate rock from Montana has arrived at the Kimberley, B. C., plant of Consolidated Mining & Smelting Co. The $9-million Kimberley fertilizer department got its first electric power June 11, and hopes to use raw material for test runs and stockpiling during August and September.

★**Estella Mines Ltd.** hit the jackpot in its first diamond drill hole at the Little Gem gold-cobalt-uranium property in the Bridge River area. Two apparently parallel occurrences only 10 ft. apart were found to carry high values on gold and cobalt with uranium values still to be determined.

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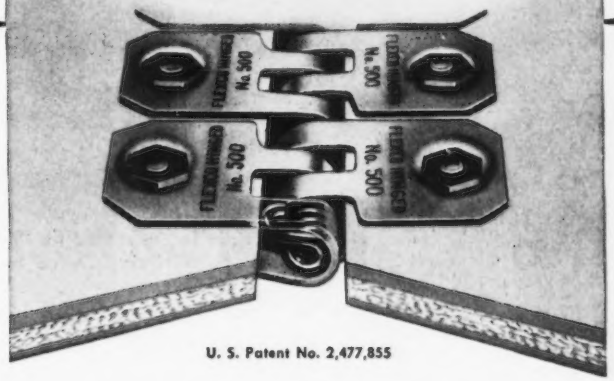

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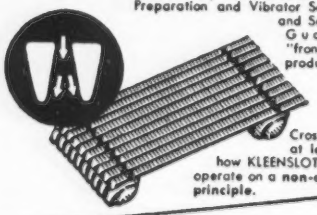

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British Columbia *(Continued)*

Estella acquired the right to purchase an 85% interest in the Little Gem property in January. A uranium rush in the Bridge River district several years ago centered on the Little Gem.

★**A new mining company,** Allied Mines Ltd. is preparing for mine development in the Kamloops mining division, having acquired 10 claims from Allied Mining & Development Ltd.

QUEBEC

★**Sales** of held-over copper in the early months of the year are given chief credit for a new record of half-yearly earnings established by Noranda Mines in the first six months of 1953.

Progress continues to be made by both Noranda's developing subsidiaries. Gaspe Copper Mines, establishing a 6,500-ton operation 60 miles west of the tip of the Gaspe peninsula, Quebec, expects to have its mill operating by the fall of 1954, and a smelter a year later. Noranda's other new project, the Macdonald, also is making headway, with plans on the drafting boards for a 1,500-ton mill. This prospect, a zinc-pyrite property, is just a few miles from Noranda's own Horne mine.

★**Shaft sinking** has been resumed by New Calumet Mines at its lead-zinc property 60 miles west of Ottawa. The new No. 4 production shaft is to be carried down to 2,200 ft. as originally planned, with levels to be opened at 1,625, 1,750, 1,875, 2,000, and 2,175 ft. Sinking was stopped late last year when falling metal prices left the company's treasury depleted; but cash position has since been bolstered by injections of new capital and the new work was underway.

★**Golden Manitou Mines** (Bourlamaque area) has encountered a new orebody on the bottom level at 2,330 ft., where first drifting has disclosed a length of 450 ft. averaging 8.88 ozs. of silver, 1.51% lead, 8.1% zinc, plus gold values, across an average width of 13.5 ft. The new find is made specially welcome by the fact that it occurs west of the shaft in an area that was previously thought to be barren.

★**Noranda Mines Ltd.,** Toronto, has contracted with Macdonald Mines Ltd. to participate in a newly-incorporated firm which has acquired the westerly sections of the original Macdonald Mines' property. This property contains a zinc-pyrite orebody which Noranda previously held under lease. Plans are being prepared for a mine plant and mill to treat 1,500 tons of ore daily, according to company officials. *(Continued on p. 178)*

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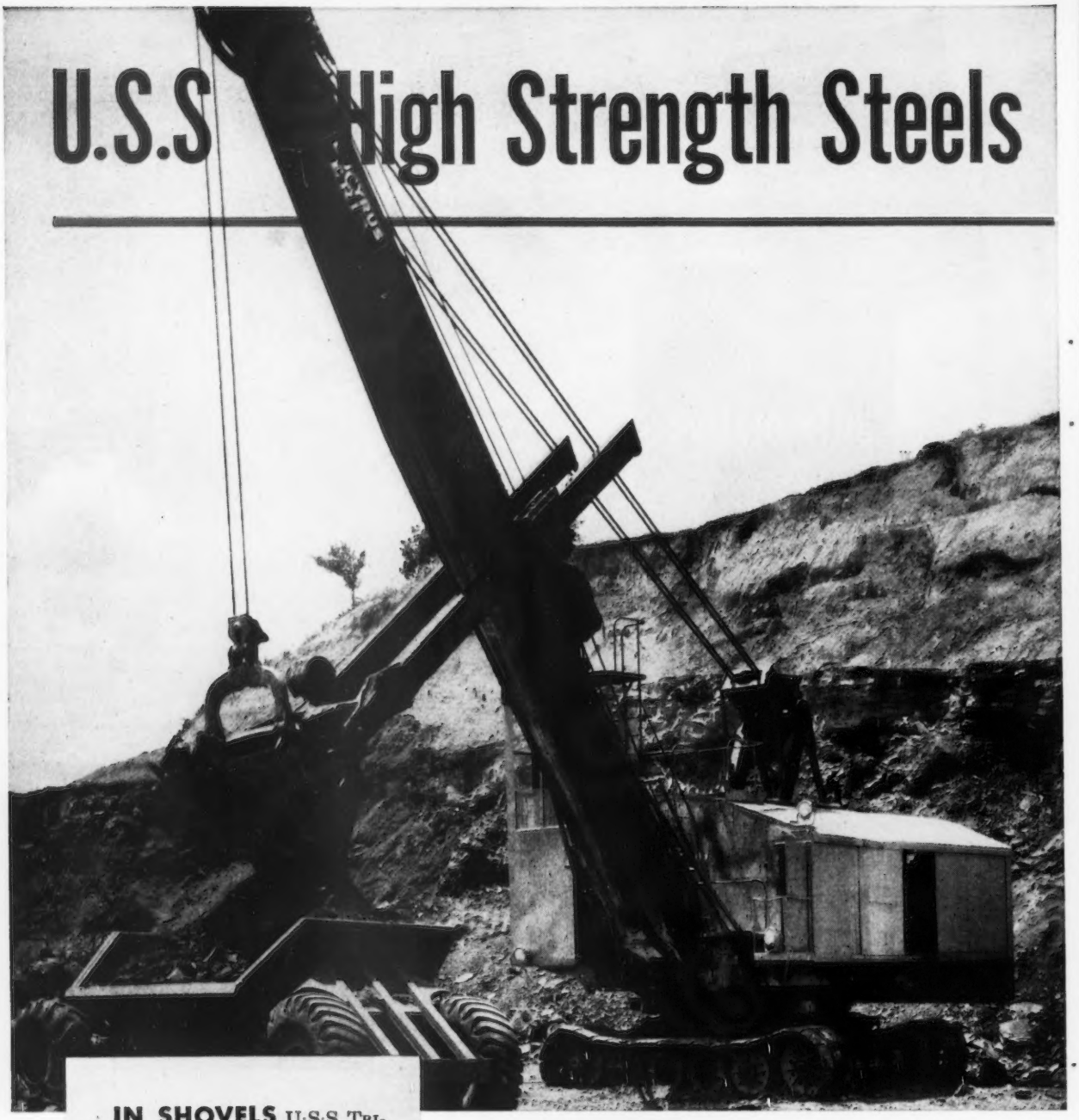

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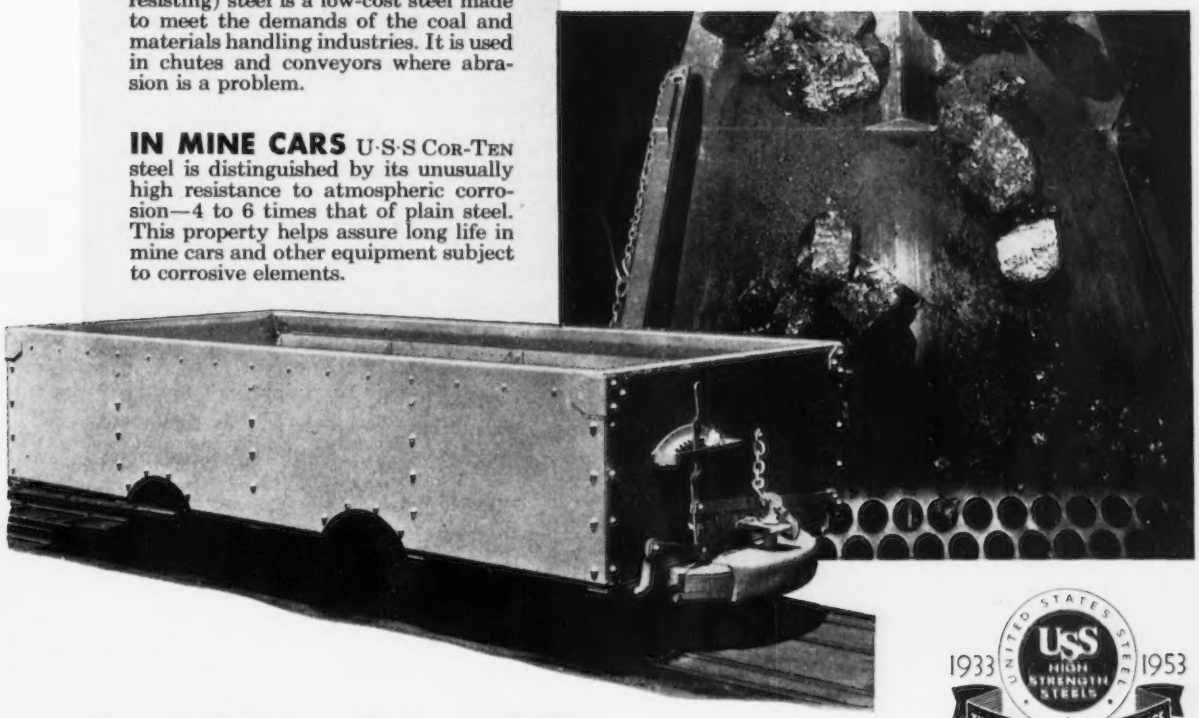

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U·S·S MAN-TEN and U·S·S TRI-TEN steels have a yield point 50% higher than that of ordinary steel. Parts ordinarily prone to failure can be made highly resistant to wear, fatigue and shock. U·S·S COR-TEN steel, in addition to having these same properties, offers resistance to atmospheric corrosion. And, U·S·S A-R steel can give maximum resistance to abrasion.

This means you get maximum durability in your equipment and therefore maximum use.

You save the *work* of frequent repair jobs, you save the *time* lost by frequent breakdowns, and you save the *money* spent for frequent parts replacement.

Because U·S·S High Strength Steels have 50% higher yield point you can increase the strength of parts *without increasing their weight*. Or, you can use these steels in lighter sections and *reduce weight* without reducing the present strength of your equipment.

These famous "steels that do more" have been used by the mining industry for almost 20 years. Our engineers will be glad to show you how they can be used to add strength and durability to your equipment.

Phone or write our nearest office today.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND · COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH · TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

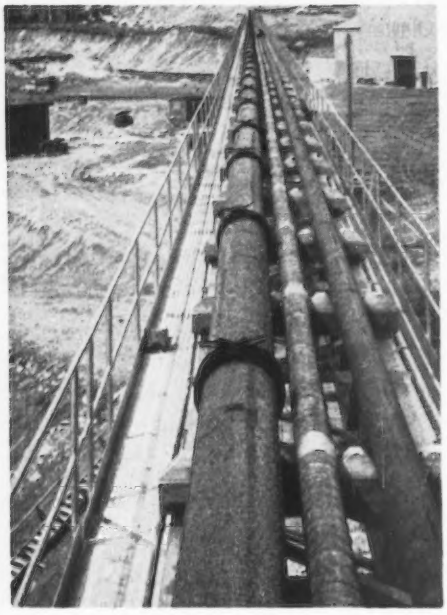
U·S·S HIGH STRENGTH STEELS

USS

UNITED STATES STEEL

INDUSTRY NEWS IN BRIEF . . .

EFFICIENCY OF WOOD STAVE PIPE FOR MINING WASTE DISPOSAL OBSERVED IN SANTA FE INSTALLATIONS



MOUNTAIN IRON, MINNESOTA... 8500 lineal feet of machine banded, wood stave pipe was supplied by the Santa Fe Tank & Tower Company, Los Angeles, for disposal of *mine tailings* in the Mountain Iron region. This pipe line has an inside diameter of 8 inches, and carries the tailings a considerable distance to a disposal area. Actually, wood stave pipe is made to measure from 2 *inches* to 20 *feet* in diameter. Such installations are being extensively used at mining operations throughout the world for carrying water, chemical solutions, etc.

The popular use of wood stave pipe in mining installations has a number of very definite advantages, according to Santa Fe engineers. Aside from its natural *economy*, wood pipe is not affected by corrosion. Its large *flow* capacity does not decrease with age, nor is it affected by electrolysis. Wood stave pipe neither expands nor contracts in varying high and low temperatures, and therefore does not require costly expansion joints necessary with other types of pipe.

Wood stave pipe has proven to be most efficient for *tailings disposal*, particularly, because it offers a *hard* wearing surface to abrasive materials. It's easy to install and requires little maintenance.

Santa Fe plant facilities and inventory are among the largest for this specialized type of wood pipe construction. Branch offices are maintained in all principal cities. For complete information and engineering data on Wood Pipe, Cooling Towers, Cylindrical Gas Scrubbers, and other industrial wood specialties, write Santa Fe Tank & Tower Company, 5401 S. Boyle Ave., Los Angeles 58, Calif.

YUKON

★**Comstock Keno Mines** has resumed work at its property in the Keno Hill area. Drifting on the Gambler claim will be continued, according to an official. An extension of 314 ft. was completed last fall with an exposure of a 20-ft. section which averaged 0.9 ft. in width and assayed 55% lead and 72 oz. silver per ton. The company also plans to drill on the Nabob claim.

★**Hudson Bay Mining & Smelting Co.** is using 8 diamond drills and is employing 70 men on its property in the Kluane Lake area.

MANITOBA

★**Sherritt Gordon's** Lynn Lake railway may be completed by October, a month ahead of schedule. The development of the "A" orebody for production is nearing completion and permanent hoisting equipment is being installed. The "EL" shaft has been completed and the orebody is now being developed for production.

★**San Antonio Gold Mines Ltd.** has announced a tonnage reduction to 400 tons daily due to labor shortage. Underground development work also is restricted by the available labor supply. The company reports also that work on its copper-gold prospect at High Lake, Ont., has been suspended.

SASKATCHEWAN

★**Calder-Bousquet Gold Mines Ltd.** is starting diamond drilling on its 600-acre Beaverlodge property adjoining the Rix Athabasca Uranium Mines Ltd., Goldfields Uranium Mines Ltd., Gui-Por Uranium Mines Ltd. and Metals Ltd. developments.

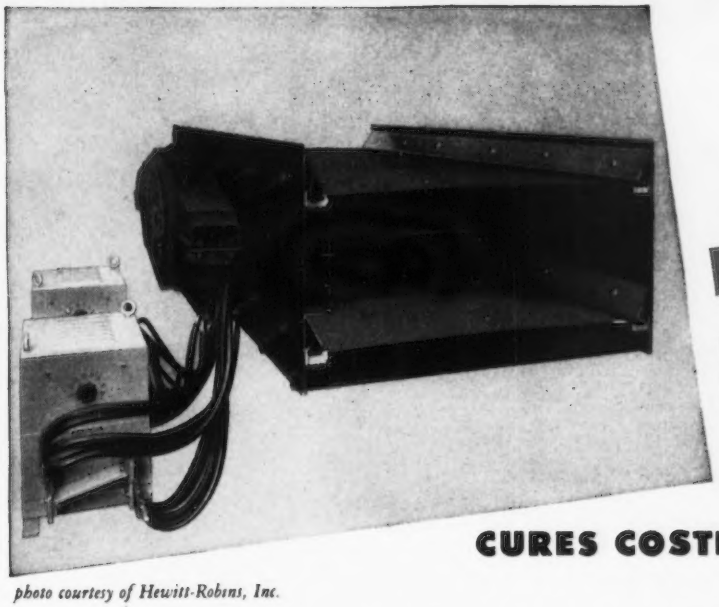
★**Clix Athabasca Uranium Mines Ltd.** reports line-cutting, mapping and prospecting work preparatory to start of a major diamond drilling program is now under way on its 1,640-acre Beaverlodge property.

★**Tetra Uranium Mines Ltd.** is launching a surface exploration program on its nine-claim property in the Beaverlodge Camp adjoining the south of the BT group of Beta Gamma Mines.

IN AUSTRALIA

★**Queensland's** big gold and copper mine, Mount Morgan, is experimenting with two important metallurgical processes which the company hopes will reduce high production costs. The

(Continued on page 182)



HEATING NOT BEATING

CURES COSTLY SCREEN BLINDNESS

photo courtesy of Hewitt-Robins, Inc.

The practice of beating blinded screens, a temporary cure at best, runs up labor cost and causes excessive screen failure. Hanco Screen Heaters forever eliminate costly, inefficient sizing resulting from blinded screens.

SCREEN HEATING REDUCES SIZING COSTS

1. Labor cost is cut by elimination of cleaning labor!
2. Screen life is greatly extended for it is no longer damaged by manual cleaning!
3. Sizing is more accurate and faster for processing equipment can be operated at full capacity!

(Every Hanco installation has paid for itself in less than a year!)

EASY INSTALLATION ON ALL SCREEN MAKES

Hanco electric screen heaters are furnished as a complete kit—heater unit, lead cables, copper distribution and feed bars and skirt boards. All necessary small parts and complete instructions are included. Hanco units are designed to match original fittings. Speedy installation can be made by competent maintenance personnel.

HANCO QUICK-CHANGE ASSEMBLY

Available in five styles, Hanco quick-change assemblies assure easy cloth changes. Special skirt boards or tension rails incorporate a wedge type copper distribution bar that is bolted to but insulated from the rail itself. One of the five assemblies shown below is sure to fit your make of screen. Cloth changes are as easy or easier than on an unheated screen.

A-8074

HANCO SCREEN HEATER ADVANTAGES

1. Hanco heaters have a wide application for they heat brass, plain, stainless and monel steel screens.
2. Unique tap changing device allows screen temperature adjustment under load. This means added economy, for you can quickly adjust to seasonal or load demands.
3. Heater terminals are readily accessible for inspection or adjustment.
4. Compact heater units can be floor, wall or ceiling mounted.
5. There is always positive direct contact with the hook strip of the screen cloth.
6. All electrical contacts are shielded from abrasion.
7. Cloth changes are as quick and easy as they are on unheated screens.

HANCO HEATERS ARE AVAILABLE ON MOST NEW SCREEN EQUIPMENT

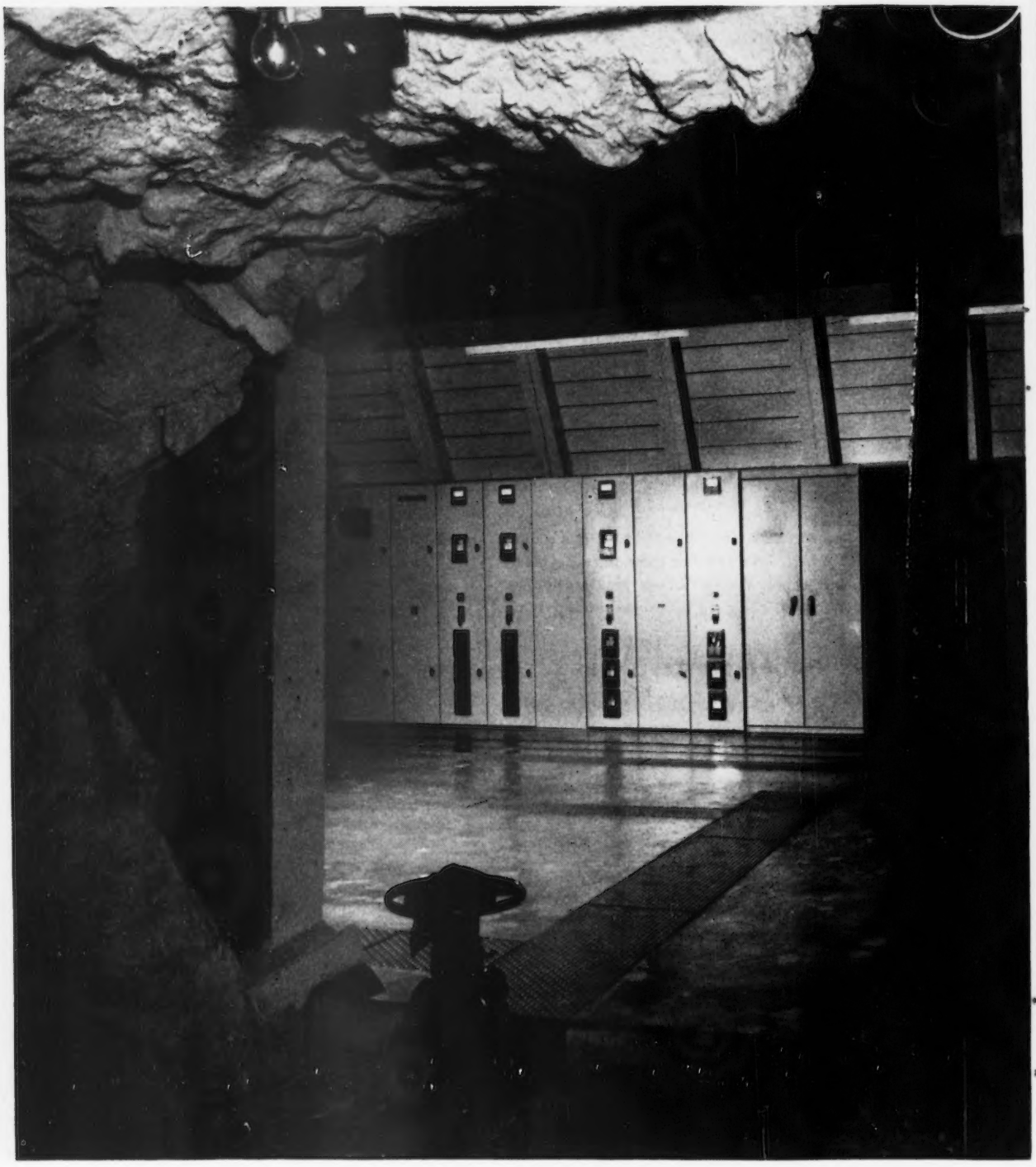
Send today for descriptive bulletin

Hanco

the pioneer electric screen heater

F. R. HANNON & SONS • CANTON 7, OHIO

Engineers & Manufacturers Since 1926



Compact Westinghouse power centers give Silver Summit excellent voltage regulation because they were compact enough to be installed close to the load. Shipped as completely assembled and tested units, they reduced installation expenses.

Does this picture answer your mine's growing power problems?

If your power system isn't keeping pace with growing operations, you may get some good ideas from this Westinghouse installation in the Polaris Mining Company's Silver Summit mine in Idaho. Rapid growth, plus the discovery of new ore bodies, made the old distribution system inefficient and hazardous. Westinghouse helped the Mining Company's engineers plan a new 13,200-volt primary distribution system with underground power centers for low-voltage requirements.

13,200-volt system and power centers lick problems

The original 2400-volt system had high line losses because power was carried by long, cumbersome cables. Also, there was a serious thermal capacity problem because each piece of additional equipment put more load on already overloaded cables. Now, there is ample power for all present and future needs. By locating efficient Westinghouse power centers close to the load, short cables carry power where it's needed. Voltage regulation is excellent and thermal capacity problems don't exist.

Safety, dependability, low maintenance

Old oil-filled transformers and circuit breakers were mounted in any suitable space that could be found. Preventive maintenance was difficult due to the lack of flexibility in the system. As a result, there was a fire hazard because the breakers often failed to interrupt their rated capacities. Now, modern Westinghouse air-cooled transformers and air circuit breakers give Silver Summit absolute safety and dependability. There's no oil to explode, the units are foolproof, and require hardly any maintenance . . . just an occasional check.

Inexpensive installation

Installation costs were low because all Westinghouse equipment was shipped completely assembled, pre-tested and ready to hook up.

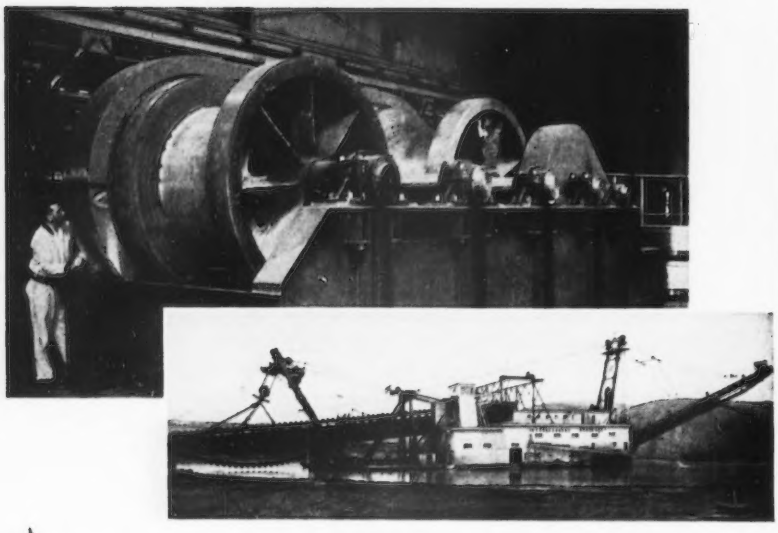
Westinghouse can help you plan your power system

Overloaded and outdated power systems are often causes of repeated trouble and costly delays in production. Ask your Westinghouse representative to help you plan a modern, trouble-free distribution system for your mine or surface plant. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-94985

YOU CAN BE SURE... IF IT'S

Westinghouse

YUBA-BUILT HOISTS
Lift 1000-Ton Loads



Typifies Machinery We Can Build to Your Order

This YUBA-built double-drum dredge hoist is designed to handle 194-foot digging ladder and is capable of lifting 800 to 1000 tons. Single-drum hoist (bottom) built by YUBA for tramway carries 5200 feet of wire rope. We're old hands at building such machinery. Every bucket ladder dredge Yuba has built combines many special "machines"—hoists, conveyors, drives, screening and metal saving equipment, winches, pumps —all designed and built by Yuba.

Experience and Facilities

YUBA's manufacturing experience includes grooved drums for large gate hoists, barges, steel and chemical plant equipment, construction rigs, clamshell buckets, ordnance, other custom work, and structural steel production. Parts for field assembly are fitted and match-marked before shipment to insure accuracy.

Our facilities include shops for carbon and alloy steel forging, heat treating, steel fabricating, welding, pattern work, iron and bronze castings, and machine shop capable of handling single large, heavy pieces. We have long experience in properly preparing and documenting export shipments.

Send us your drawings and specifications for estimates. No obligation. Wire, write or call YUBA TODAY.

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65

Australia *(Continued)*

processes are designed to obviate the smelting and electrolytic refining of blister copper. One process produces ammonia sulphate as a by-product, and this has extensive use in Queensland as a fertilizer for the sugar industry.

The Commonwealth Scientific & Industrial Research Organisation is assisting the mine and has built a pilot plant in Melbourne. Object is to leach the copper out of the ore, and produce copper by electrolysis. This would mean a saving of approximately £A50 ($125) a ton on present costs.

The other process is to leach the copper with ammonia and oxygen at high pressures. By using a reducing agent, almost a pure copper has been obtained. The company's annual output is about 6-7,000 tons of copper, and it is hoped that the processes outlined will save about £300,000 ($750,000) annually.

★**At the Government-operated** Radium Hill Project in South Australia (partly financed by Export-Import Bank funds) concentrates are now being produced on a pilot plant scale. The sinking of a six-compartment shaft was commenced last year and contracts for the purchase and erection of buildings and equipment have been awarded.

★**Australian rutile producers** expect an improvement in prices to follow an expected upsurge in U. S. demand for titanium. New rich deposits of rutile have been recently discovered and a more intensive boring campaign is being arranged but the whole industry is still operating in a relatively primitive way.

★**Federal Government's** approval of the development of the great bauxite deposits in Machinbar Island may be delayed as a result of demand for priority to South Gippsland deposits of bauxite.

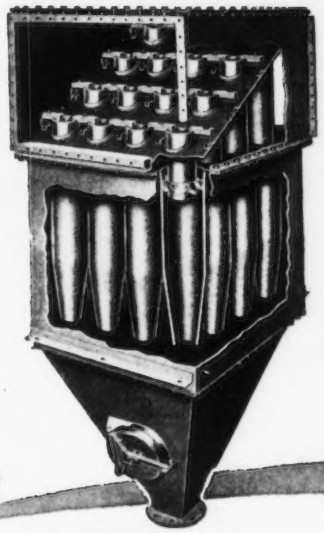
At least 10-million long tons of good quality bauxite is available on the Island. Development is estimated to cost £A500,000.

★**In Western Australia** a new tin mine started operations at Greenbushes. Overburden has been shifted from the lode and the treatment plant started operations.

★**Merloo Gold Mines N.L.** has struck a new rich lode believed to average an oz. of gold to the ton. A winze already sunk vertically for 13 ft. in average values exceeding an oz. has passed on to the footwall.

★**Governments** of United States and United Kingdom reportedly have advanced more than £A1-million in the past five months through the combined development agency of AEC to develop the Rum Jungle uranium field in Northern Territory. The main shaft has been sunk at the mine, pit head gear erected and administrative and laboratory buildings established.

Before you buy *any* equipment for recovering dust . . .

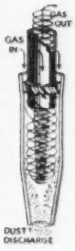


COMPARE ALL OTHERS against MULTICLONE'S Multiple Advantages

Because the advantages of MULTICLONE are so clear-cut, so vitally important, so far-reaching in the savings they make, we urge you to make a factual unbiased comparison of MULTICLONE dust collection equipment against *any other* in the mechanical recovery field. Only by making such a comparison can you fully appreciate the major savings and greater performance you get by installing MULTICLONE Collectors!

COMPARE Recovery Efficiency!

It is a recognized fact that the separating efficiency of a cyclonic tube *increases* as the tube diameter *decreases* because smaller tubes generate greater centrifugal forces. The patented vane in the MULTICLONE makes the use of small tubes *practical* without complicated manifolding and permits compacting many small tubes into one simple, highly efficient unit. MULTICLONE's higher centrifugal forces throw out not only the large, medium and small particles, but also an unusually high percentage of the *extremely small* particles of 10 microns and less. Result—*more complete recovery of all suspended particles from the gas stream!*



COMPARE Space-Saving Compactness!

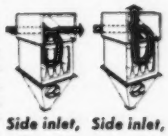
Plant space costs money—particularly at today's high construction costs. Because the MULTICLONE is more compact, size for size, it makes *really important* savings in space and plant costs. Note in the chart how the MULTICLONE requires substantially less space—*both in floor space and cubic space*—than any other unit of comparable capacity and performance. *This means vital savings in construction costs!*

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

COMPARE Dollar-Saving Adaptability!

Savings in space is just one of many ways MULTICLONE reduces installation costs. Because the shape of the unit can be readily varied (long and narrow, short and wide, or square) to fit available spaces, the MULTICLONE can often be tucked into odd corners and waste areas too restricted for other equipment.

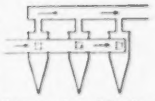
Moreover, inlet-outlet ducts can be varied—side-inlet side-outlet, or side-inlet top-outlet—to meet low headroom or restricted side clearance requirements . . . and the single-inlet single-outlet duct design permits greater flexibility and simpler installation. *These all add up to vital savings in installation costs!*



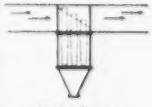
Side inlet, Side outlet ***Side inlet, Top outlet***

COMPARE All-Around Simplicity!

The MULTICLONE is simple and inexpensive to maintain because there are no highspeed moving parts to repair or replace . . . no pads or filters to clean or renew . . . nothing to choke the gas flow or increase draft losses as suspended materials are recovered. In addition, the square, flat-sided shape of the MULTICLONE and its straight inlet and outlet ducts are far simpler to install and insulate. And since the recovered material from an entire bank of tubes is collected in a *single* hopper, it is much easier to service and maintain than the multiple hoppers of conventional cyclone units. *Here again, the* MULTICLONE *saves in many ways—all of them important!*



Conventional Cyclone



Multiclone

Whether your recovery installation is in a new structure or for modernizing present equipment, you will be far ahead by installing MULTICLONE Collectors. Our experienced engineers will gladly make helpful suggestions for simplifying your recovery problems. A letter, wire or call to our nearest office places this assistance at your service without obligation.

Send for Helpful Literature! This factual MULTICLONE literature explains the basic principles of cyclonic dust recovery and gives technical data helpful to anyone contemplating a dust or fly ash recovery installation. Write today for your free copy!

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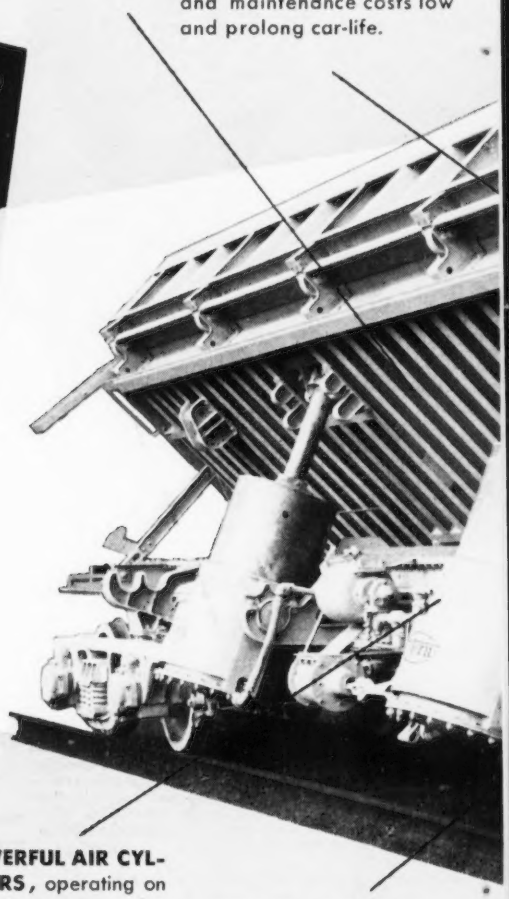
ECONOMICAL DEADWEIGHT-TO-PAYLOAD RATIO, thanks to design and use of light but strong alloy steels, means minimum haulage costs per ton-mile.

RUGGED, MAINTENANCE-FREE CONSTRUCTION . . . all welded bed underframe and extra-heavy reinforcing throughout keep operating and maintenance costs low and prolong car-life.

"Western"



largest selling dump cars in the world

POWERFUL AIR CYLINDERS, operating on low air pressure, enable *Westerns* to dump the heaviest loads effortlessly.

QUICKER DUMPING AND RIGHTING is insured by *dual side pivots.* At 30° the load transfers to an outer pivotpoint, checking the motion, and making quick righting certain.

For further information about how these modern Western cars can cut your haulage costs, write 66; Dept. Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.

BALDWIN-LIMA

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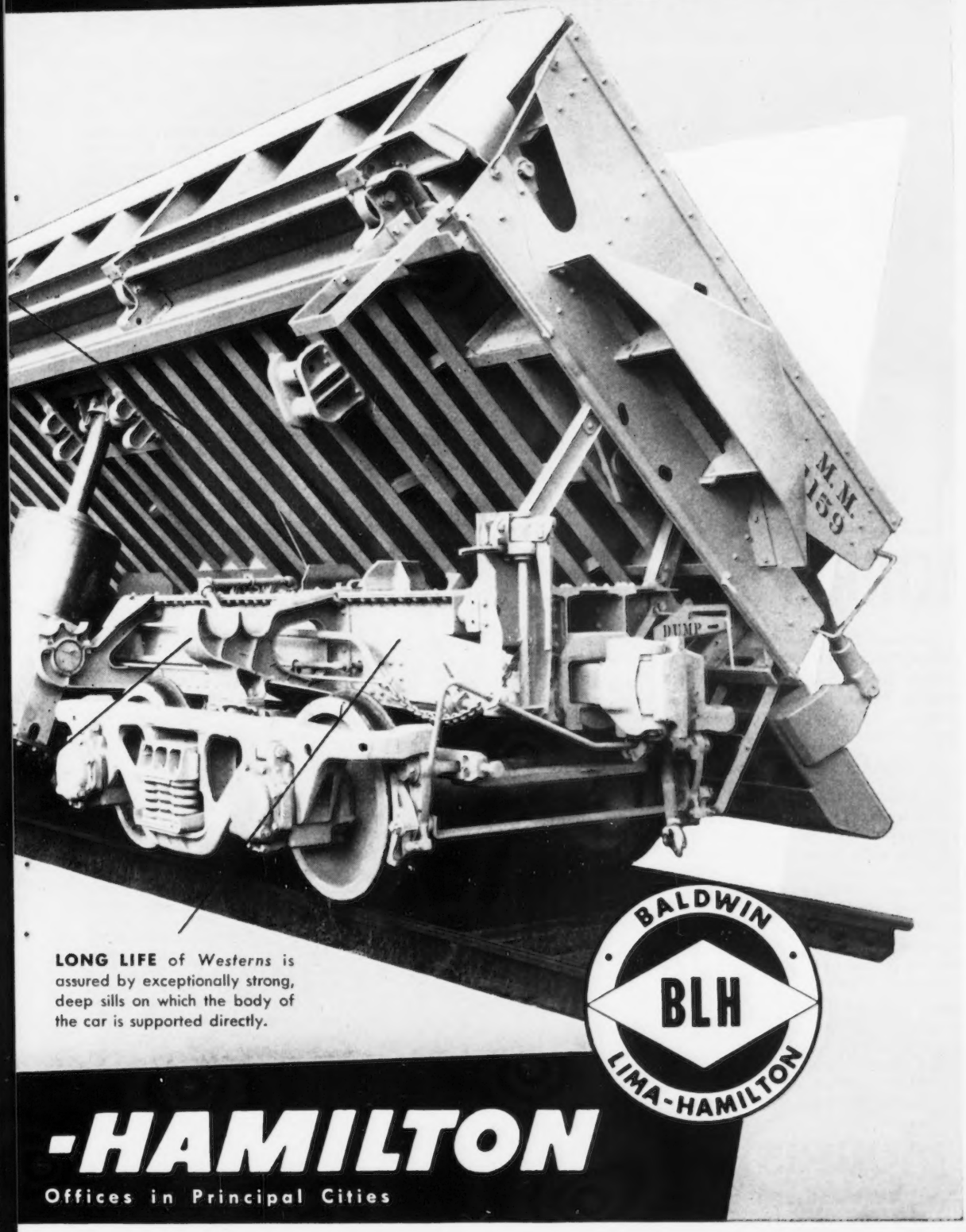
WITH THESE MODERN *Western* CARS



LONG LIFE of *Westerns* is assured by exceptionally strong, deep sills on which the body of the car is supported directly.

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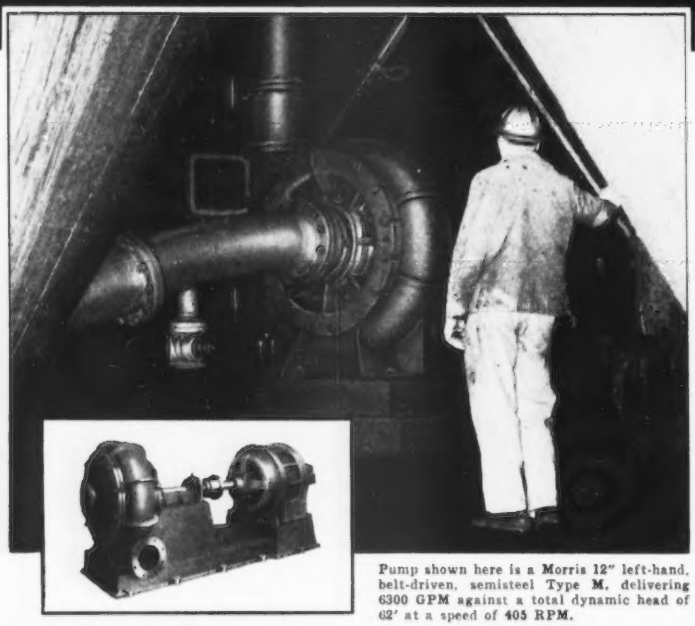
. . . for overall economy in delivering circulating water



Pump shown here is a Morris 12" left-hand, belt-driven, semisteel Type M, delivering 6300 GPM against a total dynamic head of 62' at a speed of 405 RPM.

MORRIS Type M Pump

The small high-speed pumps commonly used for circulating water are highly efficient—*if the water is relatively free of fine abrasive materials.*

When abrasive-laden water is carried, the high speed of these pumps accelerates the grinding action of gritty particles. Sealing rings are quickly cut and scored . . . the thinner casting sections break down rapidly—normal life expectancy is halved, frequently quartered.

MORRIS DESIGN ASSURES ECONOMICAL LONG LIFE

Where total heads do not exceed 120 feet, the larger, low-speed Morris type M Pump is more efficient for handling circulating water containing abrasive solids. Even the occasional big "tramp" piece—always a threat to the small pump installation—goes through the Morris without trouble. Depending on the pump size and total head, speeds range from a low of 188 RPM to a high of 1119 RPM.

Wearing parts are double the thickness of conventional clear water pumps. With economical upkeep a primary consideration in the design, sections subjected to most wear have been subdivided so that the greatest erosion bears upon smaller, less expensive parts. Optional use of special corrosion-and-abrasive-resistant alloys further increases the inherent long life on the Morris Type M.

Morris Engineers have been building pumps for all types of service for 88 years. Let them consult with you on your pumping problems. No cost. No obligation. Or, send for free Bulletin 175.

MORRIS MACHINE WORKS

Baldwinsville, N. Y.

Representative in Principal Cities

MORRIS *Centrifugal Pumps*

IN LATIN AMERICA

MEXICO

★**Sulphur** has become a No. 1 item in mining with the plant Petroleos Mexicanos (Pemex), the official oil company, which operates in its Poza Rica, Vera Cruz, oil fields. This plant boasts a 140-ton daily production. In addition, there have been forecasts by top authorities of higher output to meet Mexico's needs and allow a considerable surplus for export.

In announcing that sulphur imports are currently banned, Lic. José Ballesteros, chairman of the Sulphur Price and Distribution Commission, explained that at present Mexico is now producing more sulphur than she consumes. Officials, however, consider the situation as temporary.

★**Shortage of gondolas** for ore export to the U. S. is curtailing mining in the Galeana District, Nuevo Leon. Several companies there, including Cia. Minera Amaro y Solis, S. A., have had to curtail work because of stockpiling. Galeana mining has appealed to the Government-administered National Railways to provide it with at least 100 gondolas daily. The Railways has arranged to provide sufficient cars and locomotives to end the Galeana problem.

★**San Carlos mine** at Mapimi, Durango, is being conditioned for operation after a wall of a tunnel collapsed during blasting.

CHILE

★**Senor Herrera,** new Secretary for the Treasury, outlined future government policy toward the copper industry in a speech before the House of Representatives.

Referring to the economic position of the country, he emphasized copper's importance as a source of dollar exchange.

Because of this importance, Senor Herrera said that the government has decided to create a special division for copper in the Nitrate Superintendance. Function of this division, he explained, will be to keep the government informed at all times on the copper situation so as to be able to maintain a close control.

He announced also that a Copper Sales Corp. is to be established, the main function of which will be to sell copper abroad and keep the Administration up to date on market trends. Up to now this function has been handled by the Central Bank.

In addition, Senor Herrera promised to work out a fair policy to cope with the rate of exchange (now 19.37 pesos to the dollar for United States cop-

AERO EXPANDS USES OF AIR MAPPING

for engineering planning and development

AERO surveys have uncovered many important mineral deposits since our first airborne magnetometer survey in 1944.

But finding the deposit is only part of the job. Now AERO mappers, working with top precision instruments like the Wild Stereoplotter, are producing valuable topographic maps for engineering planning and mining developments.

With dependable AERO maps, mining engineers can plan rail lines, locate access roads, study harbor facilities, and lay out housing sites. Our maps are also used to compute overburden, locate spoil dumps, and to plan for water supply and drainage problems. Development maps for Cerro Bolivar are typical of AERO surveys, and we are at work on the mapping of other, smaller mining developments.

This $45,000 stereoplotter is only one of AERO's mapping tools for compiling precise maps at $\frac{1}{2}$ to $\frac{1}{5}$ the cost of ground surveys. Our maps are accurate to within $\frac{1}{2}$ contour interval, including our 1 ft. contour maps.

Swift AERO mapping puts mining projects years ahead. Call on the 34 years experience of our photogrammetric engineers.

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SERVICE CORPORATION
PHILADELPHIA 20, PENNSYLVANIA
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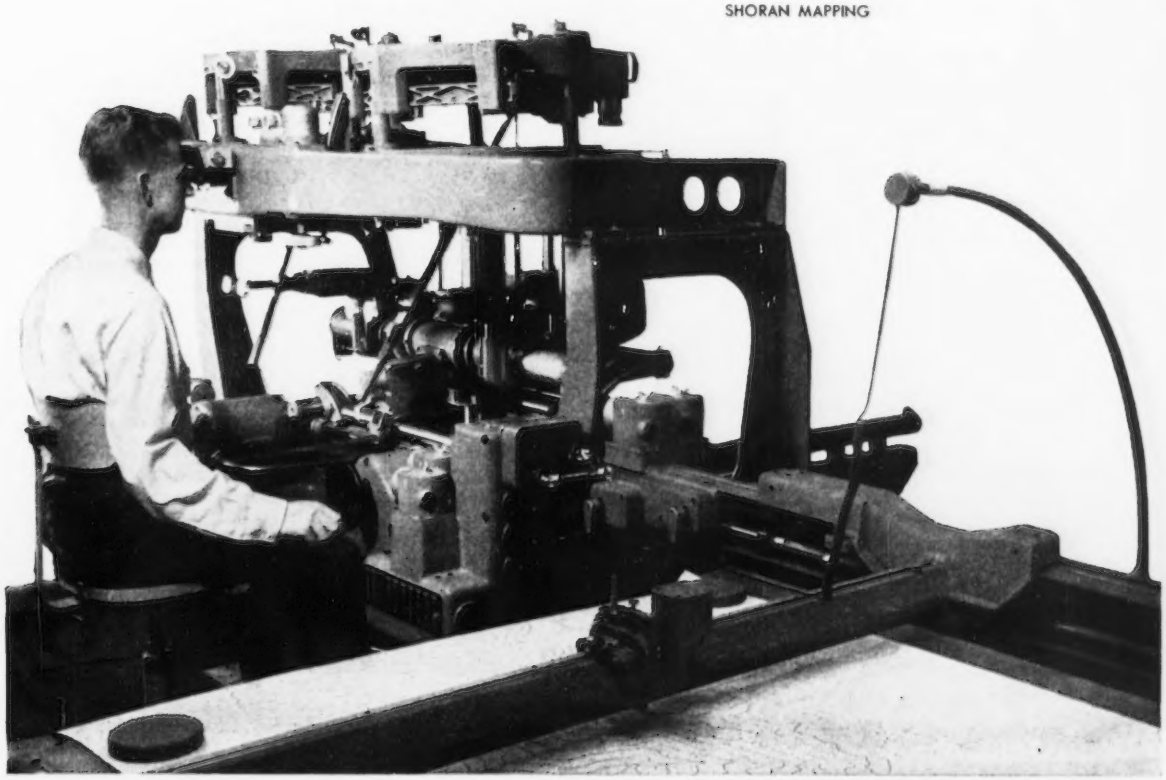
AIRBORNE MAGNETOMETER SURVEYS
PRECISE AERIAL MOSAICS
TOPOGRAPHIC MAPS
PLANIMETRIC MAPS
RELIEF MODELS
SHORAN MAPPING



The objective for this new potash plant was AS NEARLY AUTOMATIC OPERATION AS POSSIBLE, throughout every phase until the quality-controlled finished product is shipped.

3,000 tons of feed per 24 hours was the capacity sought, and every aspect of production and treatment was scaled to that figure.

Stearns-Roger engineered, designed, and constructed the plant—manufacturing special equipment in its Denver shops.

Early months of operation prove that owner and engineering contractor alike may stamp the project 'Mission Accomplished'

Another typical example of *complete* Stearns-Roger service to industry, with everything under one contract and responsibility undivided!

Stearns-Roger

THE STEARNS-ROGER MFG. CO. DENVER COLORADO

Chile *(Continued)*

per companies) that, while guaranteeing that the country will have its share of the profits, also would establish favorable conditions for expansion of production and fresh capital investment.

★**New Minister for Mines,** Senor Almeyda, announced that copper and nitrate will be under a new agency, Superintendance for Nitrate and Copper, and that the Bureau of Mines will be given additional funds to broaden and deepen its geological and prospecting units. The Mining Bank will be reorganized and will be known as the Mining & Development Bank. Adequate financial resources are to be given the revamped bank so that it will be able to aid small miners more rapidly and to a greater extent.

★**Direccion-Nacional de Mineria** has resumed exploration of Agua Tapada, important gold and manganese deposit of Catamarca. At the same time, testing of ore is underway with a view to installing a pilot plant.

★**Alunite deposit,** with estimated reserves of 26-million tons of ore, has been discovered in Patagonia, near Puerto Camarones.

★**Several discoveries** of uranium ore have been claimed recently. The most important discovery being in the Province of Mendoza near Malargue where carnotite appears with oxidized copper. The national government takes charge of developing uranium finds.

JAMAICA

★**British Aluminium Ltd.** announced in Kingston that it proposes to surrender the prospecting license for bauxite it was granted last year. The license affected an area in St. Catherine. The company reportedly had not found sufficiently high-grade bauxite to justify large-scale mining operations.

BRAZIL

★**An agreement** is expected to be signed shortly under which Brazil will supply Czechoslovakia with 20,000 tons of iron ore from the Vale de Rio Doce deposits.

★**Construction and mining** machinery in use in Brazil today totals in value some $207-million (Cr$4,144,324,000). Spare parts needed to maintain this equipment in working order during a 12-month period total an estimated $14-million (Cr$263,529,000). These figures have been forwarded to the office of the Comptroller of Currency and Credit, as a guide in determining exchange needs for imports, by the construction and mining machinery subcommittee of the National Association of Machinery, Vehicles, Accessories and Parts.

New Aluminum Sprays Without Spatter

Controlled overspray of Roylac Aluminum prevents spattered background surfaces

The special vehicle and solvents in Roylac Aluminum permit safe spray-painting where background surface spatter must be avoided. In the test below, identical spray-guns, with identical adjustments, are connected to the same compressed air source. One gun contains Roylac, the other another high grade aluminum paint.

A tarpaper background was placed four feet beyond the wire fence for this comparison test. The nearest gun contains Roylac. Roylac Aluminum dries in motion within four feet of the gun, falling away as a cottony, non-adherent powder.

After the fence is thoroughly coated, the background opposite the Roylac gun remains clear of spatter. Roylac Aluminum, with its controlled overspray, is a corrosion-resistant, plasticized, bright aluminum of outstanding quality.

Roylac Aluminum is plasticized to provide a tight bonding, corrosion-resistant film with a bright aluminum finish. It is especially effective in corrosive atmospheres. Roylac forms a tough, flexible film, effective for sealing porous surfaces. It is non-reactive with aluminum, steel, galvanized and other basic metals — won't alligator, crack or peel. Accepted as a fast-drying, economical product finish coat, it covers up to 800 sq. ft. per gallon.

For Test Sample, Specifications and Prices Write on Letterhead to:

ROYSTON LABORATORIES, INC.
P. O. BOX 112-F, BLAWNOX, PA.

★**Deposits** of titanium, barium, zirconium and vanadium have been discovered in the State of Para, it has been announced in Rio de Janeiro. Preliminary analyses of the ores were made by the Sao Paulo Institute for Technological Research. Exact location of the deposits was not revealed.

VENEZUELA

★**Venezuelan diamond production** has dropped markedly in recent months, reflecting—merchants say—a decline in the world market.

June production was 4,794.95 carats, a decline of 903.33 carats from the May figure and compares with 6,869.37 for June, 1952.

Production for the first six months of 1953 was 44,701.68 carats, almost a 10,000-carat decline from the figure for the same period last year: 54,946.54. The monthly production breaks down as follows:

	1953		1952
Jan.	8,365.89	carats	13,966.57
Feb.	7,844.04	"	5,818.04
March ...	11,753.00	"	7,568.70
April	6,245.52	"	11,252.66
May	5,698.28	"	9,471.20
June	4,794.95	"	6,869.37

Total production for 1952 was 99,280.80 carats, which, however, was the highest figure in several years.

BOLIVIA

★**The Mining Bank of Bolivia** has been informed by technicians that the presence of columbite, monazite, and fluorspar in the districts of Santa Cruz and Cochabamba has now been confirmed.

The "Amazonia Foundation" was reported here to be investing $2,250,000 to examine the columbite deposits.

PERU

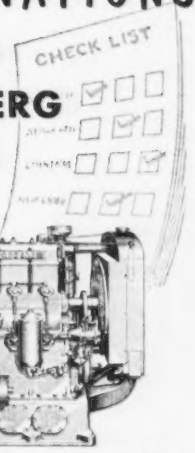
★**Marcona Mining Co.**, now developing iron ore deposits on the Marcona plateau, south of Lima, has reported completion of extensive construction work, including an airstrip, 1,600 meters in length.

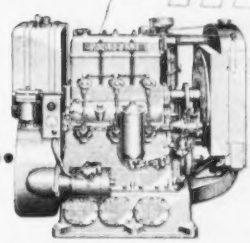
COLOMBIA

★**In Bogota**, the Colombian government declared the trade in refined gold free as of last July 1. At the same time, the Banco de la Republica announced that it was suspending the premium of 30 pesos (about $12) per oz. The bank's action, it was reported, would give a boost to smaller producers. It is expected that free trade will increase gold output. Output for the first five months of 1953 amounted to 175,194 oz. as compared with 208,610 in the corresponding period last year.

12 POWER COMBINATIONS

available with NORDBERG DIESELS





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2. For STRAIGHT POWER TAKE-OFF . . . Your choice of 1, 2 and 3-cylinder units, with stub shaft power take-off to meet power needs from 10 to 45 hp.
3. For CLUTCH-POWER TAKE-OFF . . . Your choice of 1, 2 and 3-cylinder units, from 10 to 45 hp, with twin-Disc clutch power take-off.
4. For PUMPING SERVICE . . . In 1, 2 and 3-cylinder units for connecting to pump shafts—for electric pumps—or with close-coupled centrifugal pumps—in capacities from 200 to 3000 gpm at 15 to 240 ft. total head.

With 12 basic power combinations, Nordberg Diesel units offer you an extremely wide selection to help you get exactly the right kind of power to meet your specific requirements.

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BUILDERS OF AMERICA'S LARGEST LINE OF HEAVY-DUTY DIESELS

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IN EUROPE

PORTUGAL

★**Important iron deposits** are soon to be exploited in Portugese Angola-Africa, between the Bengo and Cuanza Rivers, according to reports from Lisbon. Reserves of these deposits have been estimated at several million tons.

Located 125 mi. from the port of Luanda, these deposits have not been developed thus far because of the absence of any iron industry in Angola.

AUSTRIA

★**Austrian Parliament** has received a draft of a new mining law which would replace the antiquated Austrian mining law of 1854 and delineate mining rights.

★**Tyrolean Wipp Valley** is said to have the largest European deposit of natural kyanite, a favorite mineral for lining iron and steel furnaces. The Wipptal Bergwerks Gesellschaft (Wipp Valley Mining Co.), which discovered the deposit at the beginning of 1953, may start organized mining if the chemo-technical research turns out favorably, and if financing can be arranged.

The Pferschi and Hinteregger Co. believes that the Wipp Valley contains millions of tons of kyanite, easily sufficient to permit supplying all Europe with this mineral, which has heretofore been imported from South Africa, or manufactured chemically within Europe.

Annual European requirements for kyanite are listed at 45,000 metric tons.

FRANCE

★**French iron ore** output in the first half of this year totaled 22,060,000 tons compared with 20,229,000 tons in the corresponding period of 1952.

Overall deliveries totaled 21,841,000 tons against 20,511,000. The home market absorbed 13,526,000 tons against 12,746,000, and the Saar took 3,211,000 against 3,126,000 tons. French exports rose to 5,104,000 tons against 4,639,000 tons.

GREECE

★**German industrialist,** Berthold Kropp von Bohlen, has made a contract for iron ore with Bodossakis Athanassiades, owner of the Larymna

(Continued on page 194)

HYDROMETALLURGY OF BASE METALS

The first authoritative, completely up-to-date explanation of the art of leaching. It details the hydro-metallurgy of copper, lead, zinc, nickel, cobalt, manganese, tin, antimony, cadmium, vanadium, uranium, and radium. Here you will find a fully developed study of the newest roasting practice in a generation—fluidization. This wide range investigation of hydrometallurgy gives you its history, its chemistry, cost factors, and descriptions of current processes and plants using them. **George D. Van Arsdale, Editor-in-Chief, with the assistance of The Dorr Company Staff. 366 pp., 40 illus., $9.50**

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A practical field tool for choosing and planning mine plant equipment in keeping with specific localized conditions, operational demands, economic factors, etc. Covers surface and underground apparatus and buildings. Aids in checking suggestions from manufacturers' representatives. **By W. W. Staley, Prof. of Mining U. of Idaho. 2nd Ed., 540 pages. 188 illus., 76 tables. $8.00.**

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Revised Second Edition provides a complete coverage of non-metallic minerals—essential as raw materials to the chemical, construction, ceramic, fertilizer, and abrasive industries, as well as other important fields. Explains **where** nonmetallic minerals are found, **how** they must be treated for commercial acceptance and use, the size and distribution of markets, and price ranges. **By Raymond R. Ladoo, Consulting Engineer, and W. M. Myers 2nd Ed 605 pages, 18 illus., $11.00.**

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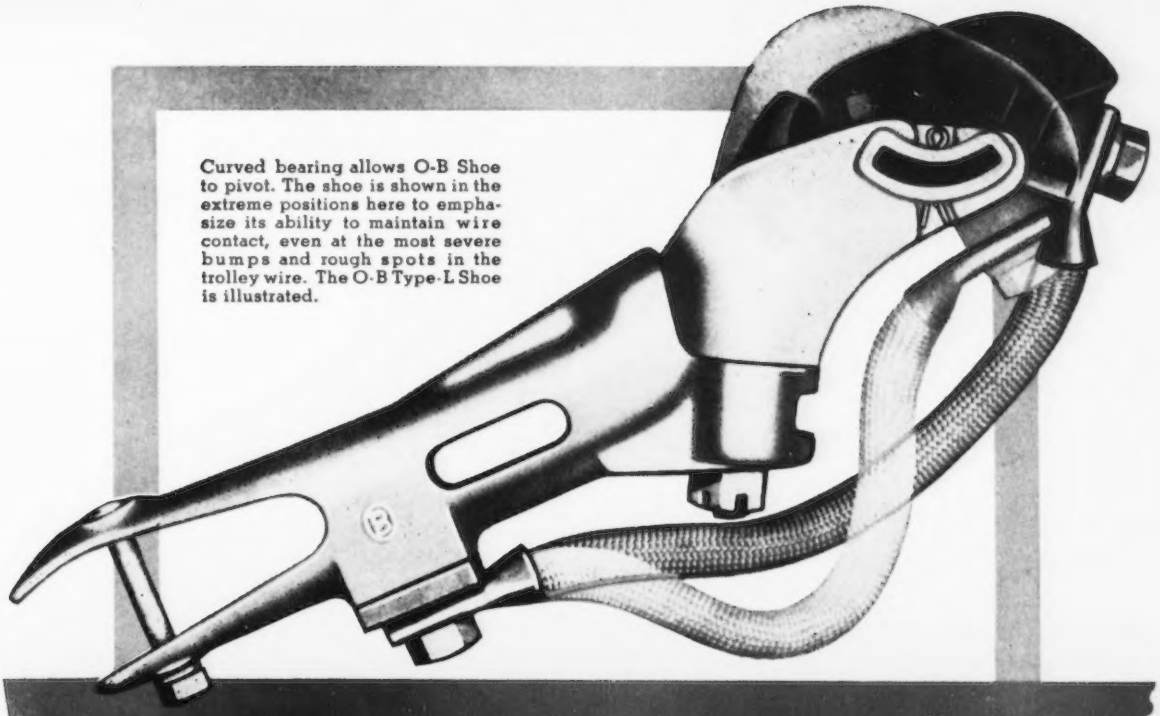

Curved bearing allows O-B Shoe to pivot. The shoe is shown in the extreme positions here to emphasize its ability to maintain wire contact, even at the most severe bumps and rough spots in the trolley wire. The O-B Type-L Shoe is illustrated.

O-B Shoes Stop Dewirements and Wire Burning

because they HUG the wire!

Pivoting O-B Trolley Shoes give you these advantages — HIGH SPEEDS WITHOUT DEWIREMENTS — LONG LIFE FOR TROLLEY WIRE AND CURRENT COLLECTORS. Sounds worthwhile, doesn't it? Here's how they give you better collector performance:

O-B Trolley Shoes *pivot* at any bump or irregularity in the wire. Thus either the trailing end or the leading end of a shoe is always in contact with the wire as the shoe passes a jog. A wheel can be jarred hard enough by the same jog to make it lose contact. That causes dewirements. Shoes avoid that trouble by hugging the wire at all times.

When a collector breaks contact, there's some arcing and wire-burning. Metal burns away. Lumps appear on the wire and collector. Wheels bounce, arc, and burn at the least jounce. Shoes avoid that trouble by hugging the wire at all times.

Save wire and save collectors by switching to wire-hugging, burn-free O-B Trolley Shoes!

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HERE'S TONNAGE LOADING

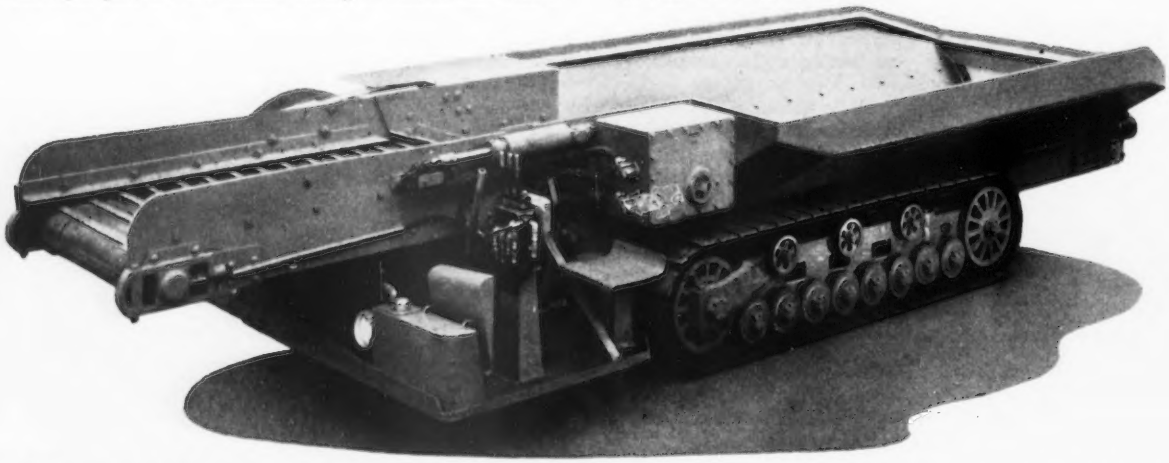
FOR METAL AND NON-METALLIC MINING

THE WHALEY CRAWLER-MOUNTED LOADER WITH COMPANION TRANSFER CAR

The Whaley Automat Crawler-Mounted Loader and companion Whaley Crawler-Mounted Transfer Car are built for effective, automatic loading to meet today's metal and non-metallic mining demands for big tonnage, fast production. Fast, consistent loading and minimum maintenance of these machines also give you tonnage loading at the lowest possible cost.

The Whaley Automat and Transfer Car are designed simply . . . each powered by a single motor. Machines are lubricated automatically by central lubrication system. The natural shovel action of the Automat's loading head permits maximum and continuous flow of material onto conveyor section. The Automat's parallel lift rear conveyor permits maximum loading in limited headroom.

The Whaley Transfer Cars have a capacity range from 180 to 349 cu. ft. crowned to 6 inches. The Flow Control body is built to permit an even continuous flow of material to conveyor section when discharging . . . with finger tip simple control of elevating conveyor, traveling and steering. Write to us for complete description and specifications on these machines.



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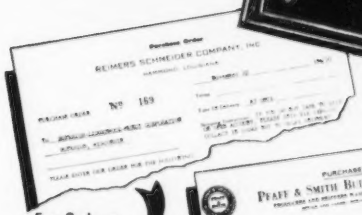
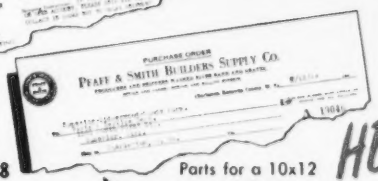
Over half a century ago Lidgerwood made a promise

"All of our hoists are built on the duplicate part system. This is a most important feature because it insures our customers of always being able to purchase repair parts."

From a 1901 Lidgerwood Catalog

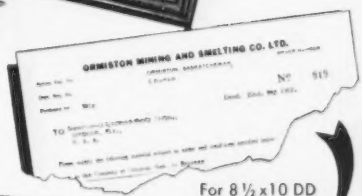


For 2 drum Steam Hoist #4472 —SHIPPED 3/28/88

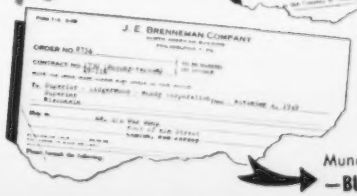


Parts for a 10x12 type engine —BUILT IN 1889

AND HERE'S PROOF POSITIVE



For 8½x10 DD Hoist Serial #9327 —BUILT IN 1893



Mundy Hoisting Machine —BUILT IN 1892

TODAY—we furnish parts for Lidgerwood and Mundy hoists *which were built over sixty-five years ago.* We've kept our promise! In addition, we have proved by the test of time—the toughest test of all—that Lidgerwood hoists are built to last!

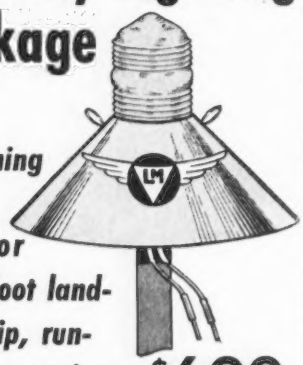
Write for bulletins and catalogs!

Superior—Lidgerwood—Mundy Corporation

MAIN OFFICE AND WORKS — SUPERIOR, WISCONSIN

NEW YORK OFFICE — 7 Dey St., New York 7, N. Y.

Complete "Flying Farmer" Runway Lighting Package



Everything you need for 2000-foot landing strip, runway, or taxiway $600

Includes 18 stake-mounted runway units with clear lens; 12 threshold units with green lens; yellow cones, lenses, lamps, control switch, Penta-treated stakes, 10,000 feet plastic-covered No. 10 copper wire for direct burial.

Now you can make safer landings in darkness, dust, or fog with a dependable, electric-lighted runway system that costs only 30¢ per runway foot for materials.

Install it yourself. Just plow 6-inch furrows for cable, drive stakes for the units, hook up to regular 115-volt AC power. Needs no transformers. Lamps are 15 watt (105 lumens), giving 27 cp output.

This is a highly effective system, made by the makers of the famous Thermal Beam (TM) high-intensity lights for larger airports.

Also available: "Flying Farmer" kits for 2500- and 3000-foot runways. Mail coupon for complete information.

LINE MATERIAL

Airport Lighting LM

(A McGraw Electric Company Division) 182

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Please send me free folder on "Flying Farmer" runway lighting packages.

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Business.....

Address or Route.....

Town.....*State*.....

Greece *(Continued)*

mines, some 30 mi. north of Athens, it has been reported.

Krupp, it was understood, will provide necessary installations for processing the iron ore. Processing plant is expected to be in operation by July, 1954. Annual output of the mine is expected to be around 130,000 tons of ore, containing 1% nickel.

Two grades of ore will be produced and much of it will be purchased by Krupp factories for further processing. Payment for the installations made by Krupp is expected to be completed by the end of 1954.

RUMANIA

★**A Rumanian newspaper** reported that the 23rd August Works (Malaxa Locomotive) of Bucharest has succeeded in producing a diesel locomotive for use in mines. The locomotive is equipped with an engine of the type used on the KD-35 caterpillar tractor. It has a top speed of 12.5 kilometers per hour, weighs 6,200 kilograms and has a traction power of 30-35 hp.

HUNGARY

★**New mixture** of cement and slag from which pit-props, arch beams and shape stone blocks were made was described in an illustrated article published recently in Hungary. The mixture was developed by a manager of a colliery and a miner. The two men experimented with huge piles of slag at the Nagbatony power station. After lengthy trials with cement, they found the correct mixture.

IN THE NEAR EAST

JORDAN

★**Hammad Garhan,** Jordan Undersecretary of Economy, stated in Amman that Jordan expects an exportable surplus of phosphates amounting to more than 100,000 tons this year and that it is aiming at an exportable surplus of 1-million tons annually by 1957.

TURKEY

★**Increased exports** of copper are expected now that the Murgul Copper Mine is in full operation. After chrome, copper is Turkey's most important mineral export.

The new mine, built since the war with modern British equipment, now becomes Turkey's principal copper mine. It is located at Murgul, only a few kilometers from the Turkish-Russian border.

Owned and operated by the Eti Bank, the mine now boasts an output rate of 12,000 tons yearly, all of which is exported to the United States and those countries belonging to the Organization for European Economic Cooperation (OEEC).

These exports bolster rearmament and net Turkey some £T40-million in foreign exchange annually. With 1,500 miners and a staff of more than 300 employees, the Murgul works currently produce a minimum of 35 tons of copper daily. It is hoped that within a year, production will have been boosted to 40 tons a day.

IN THE PHILIPPINES

★**June output** of gold by Philippine gold mining companies totaled 37,116 oz. from milling 148,234 tons. By comparison with June, 1952, tonnage increased slightly over a year ago, but gold recovered declined 6%. Average grade of ore milled in June, 1953 was 0.25 oz. per ton, compared with 0.275 oz. per ton in 1952.

Increased recoveries and higher milling rates were shown by Benguet, Balatoc, Baguio Gold and San Mauricio. Atok-Big Wedge, Itogon, and Mindanao Mother Lode declined. The price of gold was a little higher in June a year ago when it averaged 104 pesos an ounce in the open market against 100 pesos today. However, the mines are now permitted to retain the full market price for themselves instead of surrendering 25% of their production to the Central Bank at 70 pesos, as was required last year.

The table that follows shows production for June, 1953 and for a year earlier. Production of by-product gold from the base metal mines is not included.

Company	Tons Milled June, 1953	Tons Milled June, 1952	Oz. gold recovered June, 1953	Oz. gold recovered June, 1952
Atok-Big Wedge	9,677	13,070	1,912	3,640
Baguio Gold	10,643	8,988	2,802	2,120
Balatoc	38,073	36,809	6,486	7,836
Benguet	39,786	36,093	8,136	7,870
Coco Grove	(162,000 cu. yd.)	(130,000 cu. yd.)	484	474
Itogon	16,910	15,389	3,068	3,690
Mindanao Mother Lode	10,800	11,700	3,798	4,080
San Mauricio	9,220	9,312	4,986	3,980
Surigao Consol	13,125	12,320	5,444	5,908
Total	148,234	143,681	37,116	39,598

(Continued on page 197)

LOADING — High reverse speeds, power steering and high lift make the Model HM flexible and fast for loading operations with output between 100 and 150 cu. yds. per hour.

STRIPPING — The ability of the Model HM to dig and load enables it to strip overburden and load it too when advisable. Precise bucket control also insures a close, clean stripping job.

FEEDING — In many pits it is more economical and practical to feed conveyors with "PAYLOADERS." The ability of the "PAYLOADER" to feed material selectively is often a valuable asset.

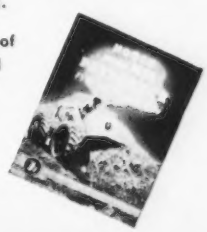
PULLING & PUSHING — The 90 horsepower engine and 4-wheel drive provides lots of drawbar horsepower for pushing, pulling and equipment-shifting work.

MASTER OF MANY JOBS

The big Model HM "PAYLOADER" tractor-shovel is popular at pits, quarries, mines and plants because it is both capable *and* versatile . . . is able to do many jobs and move quickly from place to place at speeds of 17 m.p.h. Big tires, plus 4-wheel drive, gives it catlike traction over rock, dirt and sand. Power-boosted rear wheel steering makes it maneuverable and easy to handle . . . 4 gear ratios in each direction provide the right speeds to fit each task.

The powerful 1½ cu. yd. "PAYLOADER" is the flagship of the "PAYLOADER" fleet, which includes 7 sizes down to 12 cu. ft. bucket capacity. Also a choice of 4 wheel drive, rear wheel drive and front wheel drive to best fit your needs. Your Hough Distributor, one of 200 in the U.S. and Canada, is ready to serve you *right* — with extensive application experience and complete parts and service facilities. The Frank G. Hough Co., 726 Sunnyside Ave., Libertyville, Ill.

WRITE for full information on any of the "PAYLOADER" models: FourWheel Drive HM — 1½ yd. and HR — 1 yd.; Rear Wheel Drive Models HY — 1¼ yd., HF — ¾ yd., HE — ½ yd.; Front wheel drive Models HAH — 15 cu. ft., HA — 12 cu. ft.



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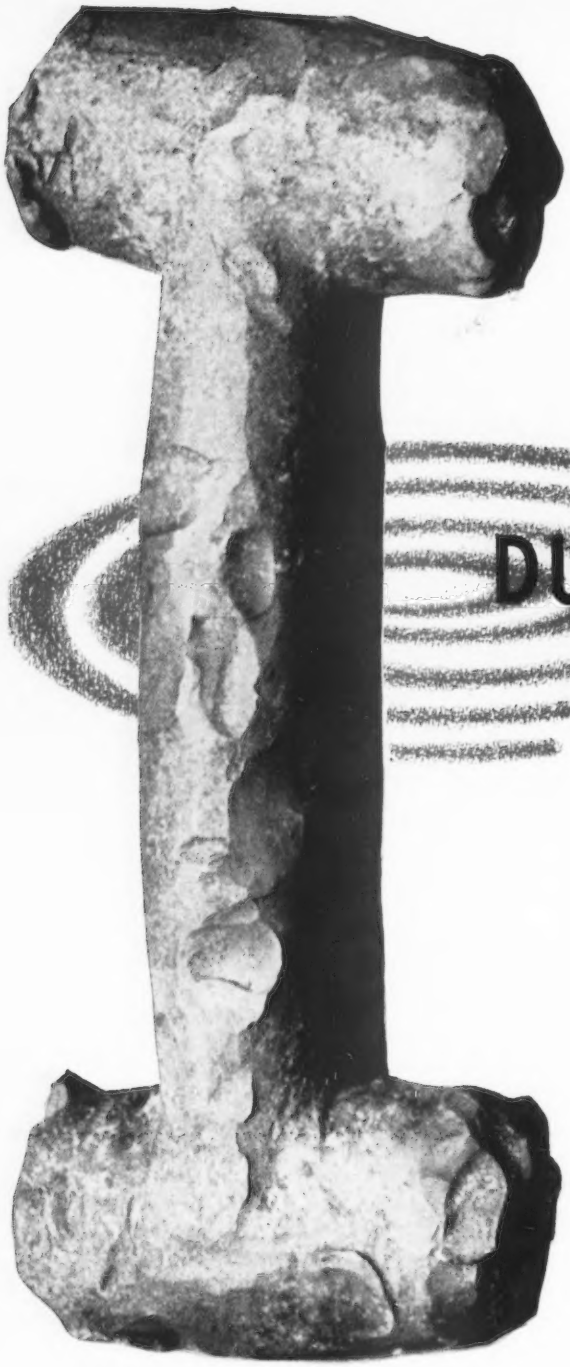
THE FRANK G. HOUGH CO. SINCE 1920



ACTUAL SIZE

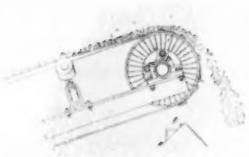
DUMB-BELL? . . .

. . . NO,

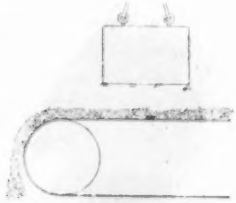
it's a big 8-inch hunk of iron that found its way into a crusher. Its scarred surface tells a sad story about that crusher and its unhappy owners who learned how economical an investment a magnet can be . . . the hard way.

Preparation plants that don't magnetically protect their crushers, belts and other equipment ought to compare the cost of tramp iron trouble with that of adequate magnetic protection.

And if your old magnets aren't doing the job, learn about the new, improved types available. *Write Dings today for* CATALOG C-5000-B.



Dings Magnetic pulley installed as head drive pulley on conveyor belt. Iron separated, discharged automatically.



Dings Rectangular Suspended Magnets pull iron out of deepest burdens, fastest moving conveyor belts.

RS153

Dings

MAGNETIC SEPARATOR COMPANY

4716 W. Electric Ave., Milwaukee 46, Wisconsin

Magnetic Separation Leader for over Fifty Years

IN AFRICA

NIGERIA

★**Tin mining** companies here have achieved a relatively satisfactory position despite the setback in the price of tin. As for tin mining alone, firms in this region face largely the same problems faced by tin mines in other parts of the world.

These few companies, however, also have gone in for production of columbite during the past two or three years and had improved their position. The Bisichi company, for instance, reportedly has been realizing a price of nearly £2,400 (about $6,720) per ton for columbite.

IN ASIA

INDIA

★**Madhya Bharat Government** has decided to reopen steel rolling mills at Barhawa, about 40 miles from Indore. The mills were started by a British firm in 1857 but were later closed. Geological surveys have shown that abundant supplies of iron ore are available locally.

IN SCANDINAVIA

NORWAY

★**The Swedish Boliden Mining Co.** has asked the Norwegian Government for a long-term concession to permit it to mine copper in Norway. The proposed mining area covers 1,000 sq. km. around Kautokeino in the inner highlands of Finnmark, northern Norway.

The company has proposed that it should set up a subsidiary company in Norway using some Swedish capital to operate the mines and processing plant. Final smelting of the copper concentrate would be done in Sweden.

According to press reports, the Norwegian authorities are inclined to accept the proposal but opposition has been developing in some quarters.

★**Experimental mining** of manganese ore layers at Bremsnuten in Telemark, southern Norway, will be started shortly by the Dutch company Intertransport of Rotterdam. A representative of the company has started work at the site with a team of eight workers.

First finds have revealed "rather rich" deposits of ore, it is stated. The experimental mining will continue for three months.

★**Copper ore deposits** found at Grimsdal in Folldal, southeastern Norway, are expected to yield at least a million tons, according to an official of

St. Mary's Cement Co., Ltd., lets a real rock hauler handle heavy limestone slabs. An Athey PD10Q Trailer and Caterpillar DW10 Tractor carry 15 tons of the rock over a 2000′ up-hill haul. Slabs weigh from 25 to 6,000 pounds each and are dropped 5′ to 10′ into the trailer. In the first year of service all five units have been remarkably trouble free — no repairs have been necessary.

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Athey trailers are *real* rock haulers. They're *built* with all-welded, reinforced, high tensile steel bodies and structural steel frames — to withstand the beating of hard rock. Loading shovels have an easy target in the wide bodies.

Operators can dump into grizzlies or hoppers with extreme accuracy, or over sides of waste dumps on the fly. Fast-acting hydraulic controls and the ability to dump either direction keep dump-time in seconds. All Athey trailers are engineered to the power and speed of tough, reliable Cat DW20 and DW10 wheel-type Tractors.

Let your Athey-Caterpillar Dealer show you how Athey high-speed rock haulers can make you more money — and send for the free cartoon book.

Gentlemen: EM-9

☐ Please send me a copy of the Athey cartoon book showing the Athey Trailer line at work.

☐ Have your dealer's representative call on me with facts and figures.

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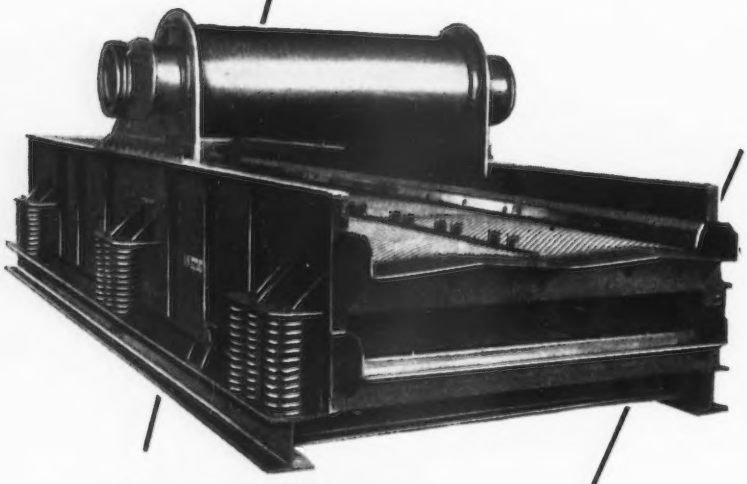
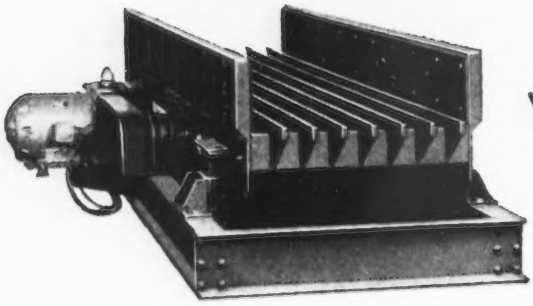
for efficient sizing and dewatering

Along the great Mesabi Range in Minnesota, Simplicity Screens like this big 6' x 20' Model OM Double Deck Screen are doing a fast, efficient and thoroughly dependable job of sizing and dewatering iron ore. This horizontal screen, with a ⅜" opening on the top deck and a 1½ MM dewatering surface on the lower deck, is especially designed for heavy media concentration. Throughout the metal mining industry, Simplicity equipment is handling all types of preparation work from coarse scalping to fine screening and dewatering. For complete information, write us today.





Simplicity heavy duty scalpers handle many tough production jobs for the metal mining industry.

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Norway *(Continued)*

the Folldal Verk, the company working the mine.

New finds at Soendre Geitryggen, on the other hand, reportedly have proved to be less extensive than expected, totaling only about 400,000 tons. Geophysical measurements have proved, however, that ore deposits may be found at several other places in the vicinity, and these will be explored later, the official stated.

SWEDEN

★**Stora Kopparbergs Bergslags Co.** announces that it has discovered 19 new iron ore deposits in the Aamaal Edsleskog and Mo districts. All these deposits are considered workable.

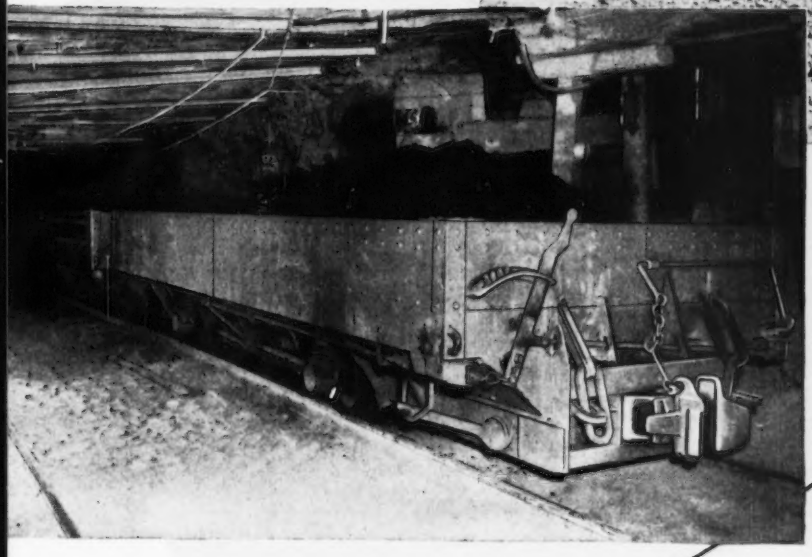
Conveyor Belts

(Continued from page 94)

Transverse rips require similar treatment with standard belt fasteners instead of rip plates. Use rip plates on longitudinal rips only and standard fasteners on transverse rips only. When holes in the belting do not permit the simple use of rip plates and fasteners, cut the hole out into the smallest possible rectangle with its sides parallel to and at right angles to the belt edges. Then, from belting remnants, cut an exact fit for the hole and insert the piece, fastening it with belt fasteners all around the patch. Cement all edges thoroughly. Where it is necessary to prevent seepage of fines through belt repairs, remove one ply of fabric from a belt remnant and place it under the fasteners and rip plates.

Vulcanized patches are superior to those described above, but require a portable vulcanizer, rubberized fabric, tie gum, cover stock, a one-ply knife and fabric pliers. In preparing a vulcanized patch, work down into the damaged belt as far as necessary by removing progressively smaller blocks of fabric with each successive ply. Clean, roughen and cement the cavity, neatly fit in blocks of new fabric and finally apply the uncured cover. Skive the edges of the patch flush, and vulcanize. Such patches cannot be made successfully unless the belt is dry, because moisture will form internal steam blisters. For this reason, large users have drying racks in their maintenance shops. Only very large users of conveyor belting will find it economical to vulcanize their own belt patches and splices. Small users may call on the manufacturer or distributor for splicing and repairs.

From
BEGINNING



to
END

CF & I's Allen Mine goes

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COLORADO FUEL & IRON COMPANY specified Willison Automatic Couplers and National Rubber-Cushioned Draft Gears *throughout* for the complete fleet of Goodman locomotives, Allison drop-bottom cars, and Differential man-trip cars at its new Allen Mine, newest and largest coal operation in the Far West.

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Willison Automatic Couplers eliminate need to go between cars to couple or uncouple . . . give faster shunting and gathering . . . less spillage . . . no uncoupling during dumping operations. And National Rubber-Cushioned Draft Gears permit greater operating speeds . . . reduce wear and tear on rolling stock and trackage . . . cut spillage substantially.

So follow the lead of the leaders—specify Willison Automatic Couplers and National Rubber-Cushioned Draft Gears for all your new or rebuilt cars and locomotives. Literature available on request.

A-1919

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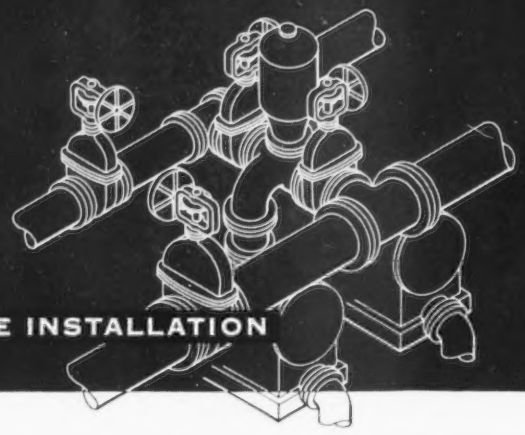
These Valves Stay on Job After 50 Years of Water Service



THE INSTALLATION

At the Beaumont City Water Works, Beaumont, Texas, with Crane gear-operated iron body gate valves in main lines in pumping plant.

VALVE SERVICE RATINGS

SUITABILITY:	*Always reliable*
FEATURES:	*Rugged design in every part*
MAINTENANCE COST:	*Routine care only*
SERVICE LIFE:	*Still in service—since 1903*
OPERATING RESULTS:	*No valve failures*
AVAILABILITY:	*Crane Catalog item—Current No. 461*

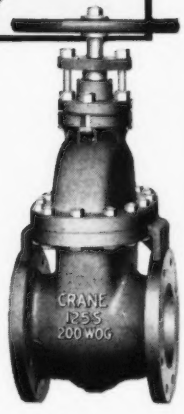
THE CASE HISTORY

Beaumont taxpayers are still benefiting by the valve quality specified for the Municipal Pumping Station built in 1903. These 14, 16, and 24-inch Crane iron body gate valves remained in their original location until the old plant was converted recently from steam to diesel power. Even then, many were merely cleaned up and put right back in service in the new plant.

For 50 years and more, these Crane valves have given outstanding service at the lowest possible maintenance cost. With but routine care, they remained tight at seat and stem, and always performed with smooth, positive action, despite infrequent operation.

Here's an example of the quality that traditionally sets Crane apart from ordinary valves. It's value like this that has always made Crane the first choice of thrifty buyers in every industry.

THE VALVE



Today's Crane 125-Pound Iron Body Gate Valves with wedge disc are building equally outstanding service records. Highly engineered for durability and dependability at low cost, these valves are now available in the most complete line of patterns and sizes, with a choice of trim for water utilities and other services. Choose to your exact needs from your Crane Catalog, or see your Crane Representative.

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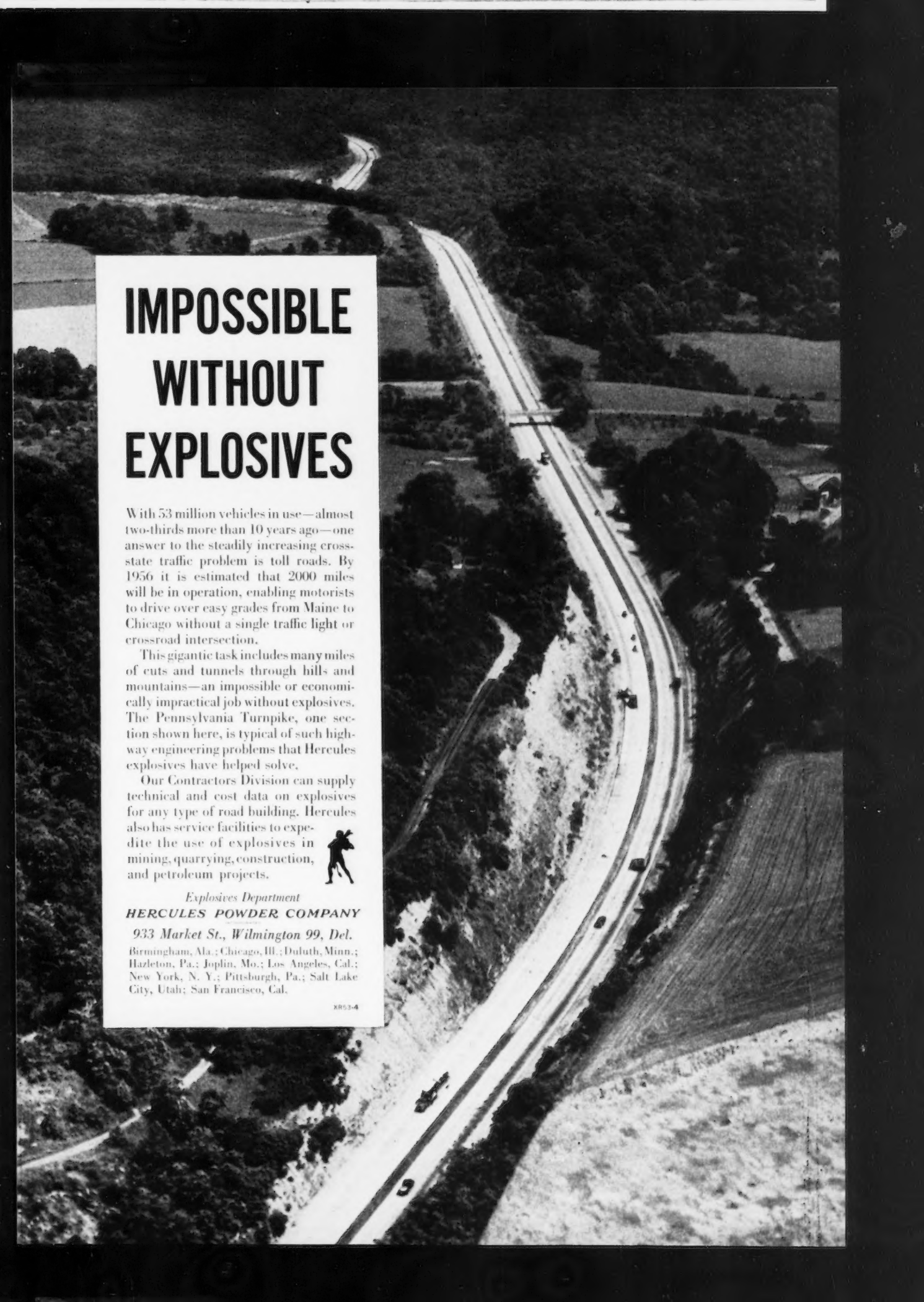

IMPOSSIBLE WITHOUT EXPLOSIVES

With 53 million vehicles in use—almost two-thirds more than 10 years ago—one answer to the steadily increasing cross-state traffic problem is toll roads. By 1956 it is estimated that 2000 miles will be in operation, enabling motorists to drive over easy grades from Maine to Chicago without a single traffic light or crossroad intersection.

This gigantic task includes many miles of cuts and tunnels through hills and mountains—an impossible or economically impractical job without explosives. The Pennsylvania Turnpike, one section shown here, is typical of such highway engineering problems that Hercules explosives have helped solve.

Our Contractors Division can supply technical and cost data on explosives for any type of road building. Hercules also has service facilities to expedite the use of explosives in mining, quarrying, construction, and petroleum projects.

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XR53-4

SCINTILLATION COUNTERS

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Model 111 (pictured above) . . $495.00
Famous Halross Model 939 . . . 975.00
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ALL TYPES GEIGER COUNTERS
ULTRA VIOLET LIGHTS
SPECIAL LONG PROBE SCINTILLATION AND GEIGER COUNTERS FOR DRILL HOLES

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CARPCO HIGH TENSION AND MAGNETIC SEPARATORS

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BELT FASTENER No. 500

FOR HEAVY CONVEYOR BELTS OF CHANGING LENGTH

These heavy-duty belt fasteners make a strong, flexible joint in conveyor belts, belts of any width and of from ⅜" to ½" thickness. They offer special advantages in mines, quarries or industrial setups where length or position of belt is frequently changed, because sections can be removed or added at will. Joints are opened for this purpose by simply pulling out the hinge pin.

Easily and quickly applied on the job or in the shop. Special design gives deep compression into belting and smooth, flush joint.

Write for Circular.

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Copperhill

(Continued from page 83)

when the significance of these results is understood, it would be found that a new fundamental contribution has been made to the budding science of grinding.

Having studied the discussion, it seems to me that Mr. B. S. Crocker offered a very good explanation when he referred to ball paths. It stands to reason that most efficient ball load is a function of the critical speed at a given temperature with all other conditions being constant. And the efficient performance of this ball load is expressed through the ball paths. So, when Mr. Crocker concludes his discussion by saying: "It may be that the phenomenon recorded at Tennessee is common to slow speed mills only," he is pointing out a very interesting possibility that the ball paths, hence the ball loads, must be tied directly to critical speeds.

I would like to go further:

I think that at a maximum efficiency or when Bond's work index is at its lowest, there is a definite relationship between ball loads and critical speeds. In other words, if:

W = ball load (% volume)
N_o = operating speed (% critical),
then $W = f(N_o)$.

In the case of Tennessee we have:
$W = 29\%$, $N_o = 63\%$.

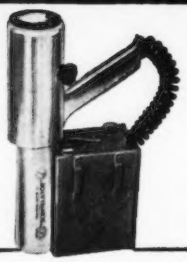
In the case of Lake Shore:
$W = 50\%$, $N_o = 81\%$.

Now, the question is: What are W's between $N_o = 63\%$ and $N_o = 81\%$? Could the mill operators supply the answer to this question? It is, of course, realized that this is not a question which could be easily answered, especially since the data must be tied to maximum efficiencies. However, it is hoped that at least a few of the mill operators might be able to help. And once we have a few values for W between $N_o = 63$ and 81%, it is my hunch that the answer would be a mathematical relationship, probably a very simple one.

In conclusion, I venture to offer a tip: to the experienced mill operator, the most efficient ball load, under given conditions, produces a sound which is like a symphony to his ears, and it is the ball paths which compose this symphony.

E&MJ wishes to thank those men who have contributed their knowledge and experience to this discussion which has appeared in the June and September issues.

PRECISION RADIATION INSTRUMENTS
TAKES PRIDE IN ANNOUNCING THE
"SCINTILLATOR"*



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• Ranges .025, .05, .25, 1, 5 and 25 MR/HR.

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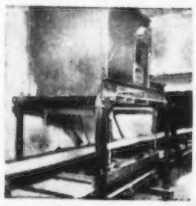
WEIGH WITHOUT STOPPING
WHILE YOU **CONVEY**



Yes, weigh and record with the —MERRICK

WEIGHTOMETER

The Merrick Weightometer provides a continuous, automatic, accurate weight record at any designated point in the mill, while material is in motion on conveyor. It weighs without interrupting conveyor service. Applicable to any size belt conveyor, horizontal or inclined. An accurate and dependable means of keeping constant check on production.

MERRICK SCALE MFG. CO. PASSAIC N. J.

GM DIESEL
CASE HISTORY NO. 1A3-12

OWNER: Georgia Coating Clay Co., Macon, Ga.

INSTALLATION: Twelve GM Diesels power shovels, Koehring Dumptors, GMC Trucks stripping 97 feet of overburden and mining Kaolin.

PERFORMANCE: Equip. Supt. W. J. Herrington reports 6-71 powering Koehring 1½-yd. shovel (background) has worked 45 hours a week, 52 weeks a year for over 6 years--about 14,000 hours--without an overhaul. Newer ¾-yd. Lima (foreground), powered by a 3-71, has already operated for 3500 trouble-free hours.

It pays to STANDARDIZE on

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DIESEL POWER

14,000 HOURS
WITHOUT ENGINE OVERHAUL

Long engine life between overhauls is only one advantage you get with General Motors Diesel engines. Power on every piston downstroke makes a 2-cycle GM Diesel accelerate faster under load – gets more work done every hour. Simple, practical design cuts down time because it does away with such trouble sources as high pressure fuel lines. When service is needed, you'll find the cost surprisingly low. GM Diesel engines are easy to work on—simple to inspect and service. And comparison will show you that GM Diesel parts cost less.

You can get GM Diesel power in leading makes of shovels, tractors, hauling units, loaders, compressors and generators. A postcard will bring you a list of the 750 different models of equipment powered by General Motors Diesel engines.

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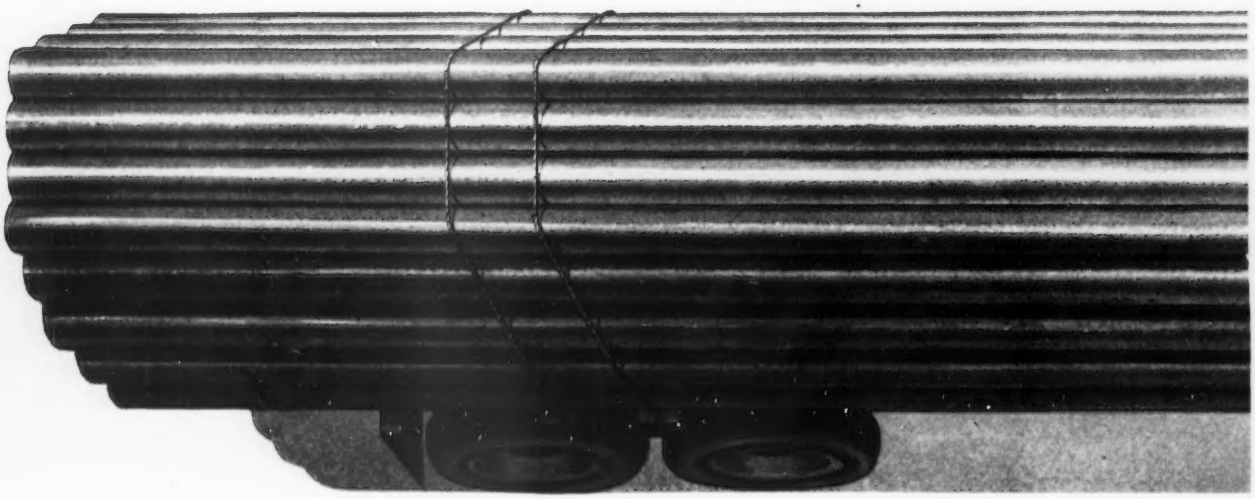
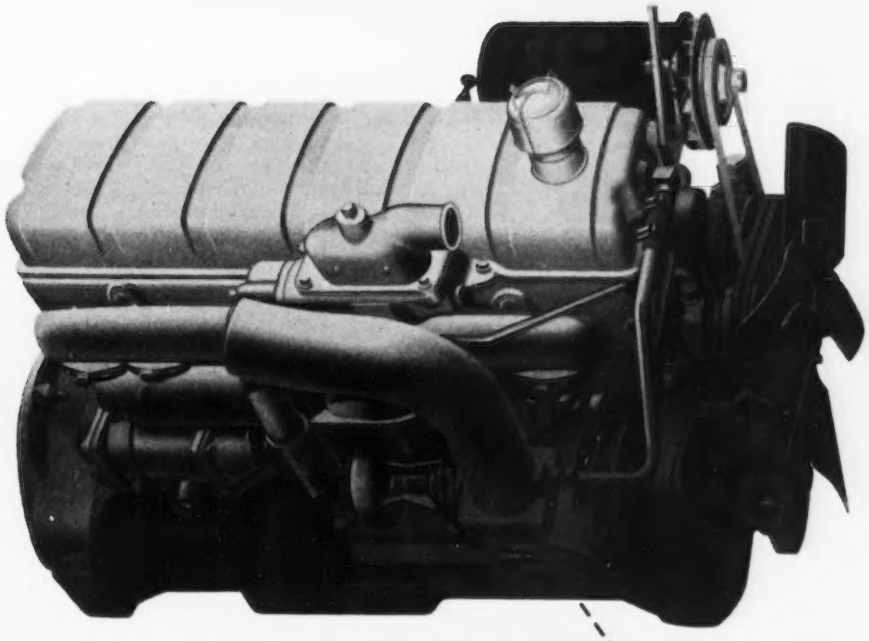
Single Engines . . . 16 to 275 H.P. Multiple Units . . . Up to 840 H.P.

If you operate medium heavy-duty trucks ...

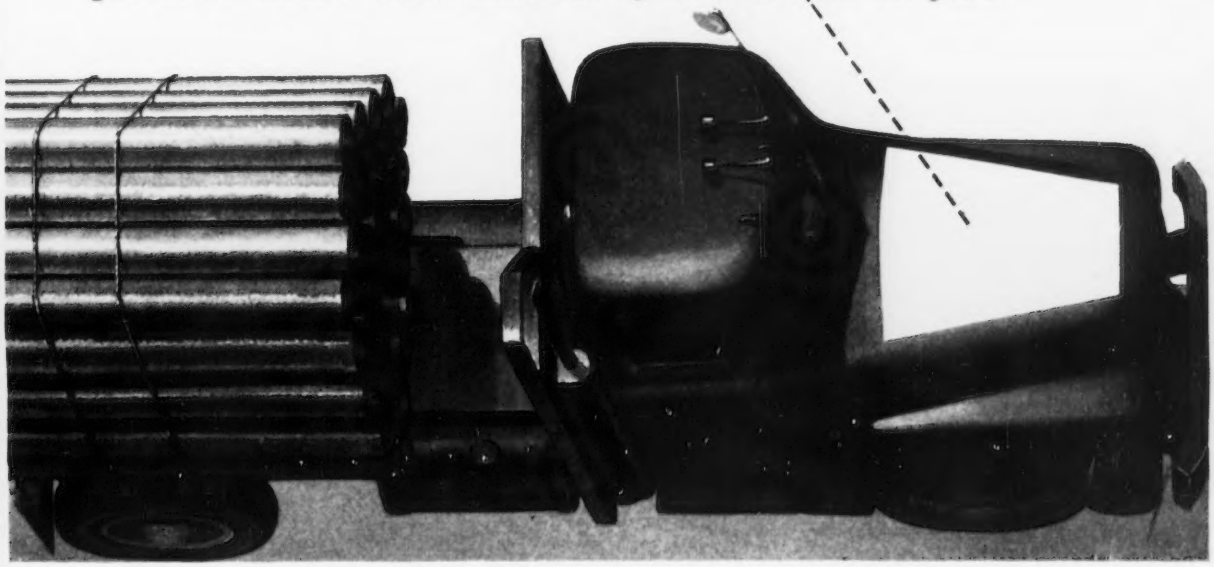
This new 150 h.p. diesel <u>now</u> makes Cummins



CUMMINS



performance and economy available to you



It's Cummins new Model JBS-600—ready to serve in the medium heavy-duty trucks produced by leading manufacturers. Ready to bring to this field the performance that has made Cummins the leader among high-output diesels. 150 h.p., the JBS-600 delivers full rated power for faster acceleration . . . for reserve stamina when the going is tough.

JBS-600 operators report more miles per gallon . . . lower fuel costs. This demonstrates the fact that Cummins' exclusive fuel and injection system—together with four-cycle operation and use of inexpensive Number 2 diesel fuel—naturally leads to savings on the job. The JBS-600 is ready to work profitably for you. It's Cummins-engineered for a long and useful life.

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Cummins® Engine Company, Inc. • Columbus, Indiana

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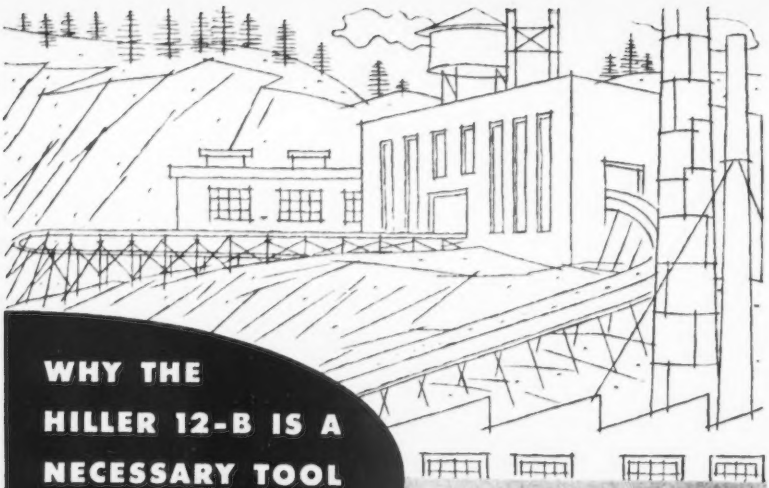

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Tough competition today requires that you take advantage of industry's most modern production tools to increase operational efficiency. Such a tool is the Hiller 12-B... a helicopter which can do many jobs for you *better, faster, more economically!*

A few uses already proved are:

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Because a helicopter can fly at very low speeds... can land and take off almost anywhere... can stop and stand still in the air... and can cruise at the speed of an average light plane, it can perform industrial functions that will greatly increase the efficiency of your operations. And because of its ruggedly built, all-metal construction, its exceptional stability, ease of control, and its 3-passenger comfort in flight, the *Hiller 12-B* is the best in the field.

Exclusive design features, proved in more than four years of successful operation throughout the world, make the Hiller 12-B the leader in its field for utility, safety, and performance.

Write or wire us today for an analysis of how you can profit by using the Hiller 12-B in your business.

HILLER HELICOPTERS 1350 Willow Road Palo Alto, California

Hiller builds a better helicopter

Cyclone *(Continued from page 99)*

7. A range of specific gravities of feed medium on ore separations.

8. Several variations in the fineness of the medium on ore separations.

The data contained in the tables should prove to be valuable in understanding the operation of cyclone separators and in determining factors which bear on plant design.

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LETTERS TO THE EDITOR

(Continued from page 4)

from Atha Albert Richie, who finally settled in Rialto, California, after many years of interesting and exciting travels and workings all over the gold-mining regions of the far West.

There are still thousands of us who were in the big mining camps of Nevada, California, Colorado, Arizona, etc., during the same period Richie writes about, and not only do we love to read about the things we witnessed and experienced during the period of 1905 to 1915, but our children, and even our many grandchildren now like to read of those same experiences—and there is no better, nor more able writer of those stories than Atha Albert Richie. . . .

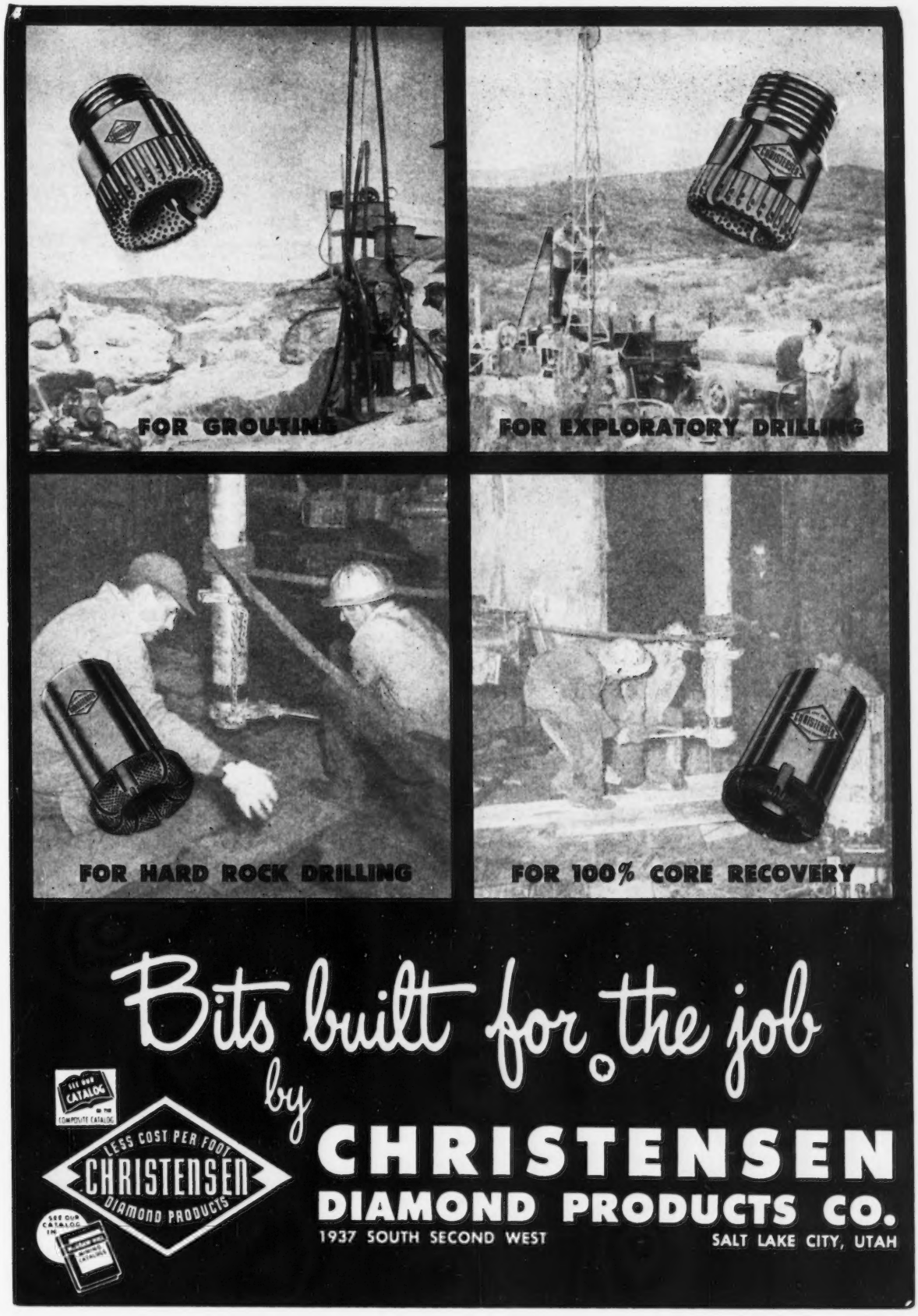
VIVIAN M. MANNING

Greenville, S. C.

Sir:

I have been reading the article in the June issue of your journal by Atha A. Richie. Fred Sander, who is turning the drill in the illustration,

(Continued on page 208)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SEE OUR CATALOG IN THE COMPOSITE CATALOG
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Positive Displacement Meters
4,000 cfh to 1,000,000 cfh.
Inert Gas Generators
1,000 cfh to 35,000 cfh.
Cycloidal Vacuum Pumps
500 cfm to 13,000 cfm.

WE *Specialize* IN YOUR PROBLEMS OF MOVING GAS OR AIR!

You may need to move a thimbleful of gas . . . or create a cyclone of whirling air. Whatever your problem, we've probably met something close to it, in experience of almost a century of building such equipment.

Another reason why we know so much about this job is that it's all we do. Our customers range from the "giants of industry" to the neighborhood plant, both of whose production depends upon continuous, reliable, economical performance of air and gas handling units. Because we build the exclusive *dual-ability* line of Rotary Positive and Centrifugal Units, in a wide range of sizes, we offer a *dual choice* which permits completely unbiased recommendations.

So—if you have a problem today—or anticipate one a year or five years from now, we suggest you call upon the facilities of R-C Specialists. Write for bulletins on any specific equipment.

ROOTS-CONNERSVILLE
Exclusive Specialists in Handling Gas and Air

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC. • 153 Washington Ave. • Connersville, Indiana

Letters *(Continued from page 206)*

and whom Richie tells of drilling with, is my husband, and like the old miners and drillers I had a feeling of nostalgia, as I held the watch and kept the time for the practice drilling in many of these contests. . . . Fred Sander and Richie's brother, Herbert, drilled at Fairview the 4th of July, 1907, and won by seven inches.

We went to Fallon, Nevada, late in 1907 and there, on the homestead, the drillers made their abode during the practice period, and I fed them homemade bread from our own ground wheat, brown rice and plenty of other good food and no fancy "grub," and they always came home with the money. . . .

MRS. FRED C. SANDER

Medford, Ore.

Cobalt Recovery

Sir:

I have read with interest your article on Rhodesian Cobalt on page 147 of your July 1953 issue. . . . The second paragraph in the article speaks of the cobalt being produced as a by-product of a high-grade alloy with copper and iron.

I wish to go on record as being the original discoverer of cobalt being contained in the reverbatory slag and being the man who developed the original process of recovering the cobalt from the slag.

This was accomplished in the year 1931 when I was employed as chief chemist for the Rhokana Corporation, N'Kana Northern Rhodesia, Africa.

I am well known to the co-author of this article, Mr. Talbot. Mr. Talbot is cognizant of my early work in spite of the fact that it is not mentioned in the article.

J. B. ZADRA

U. S. Bureau of Mines
Reno, Nev.

Credit Where It's Due

Sir:

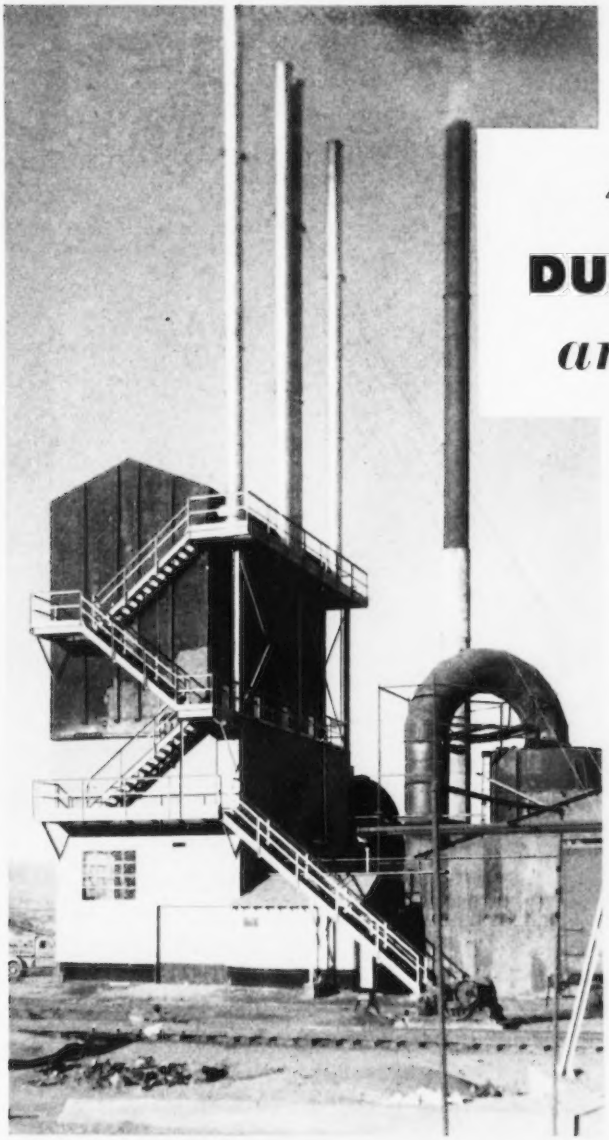
I have read with much interest your article in the July issue of *E&MJ*, "How DMEA Is Aiding Exploration," as well as the companion article on, "How DMEA Helped the Ima Mine."

I was understandably gratified by the nice tribute to A. E. Weissenborn of the DMEA and his staff." I wish, however, to take this occasion to point out that the DMEA Field Team is composed of myself representing the Geological Survey and Mr. M. E. Volin representing the U. S. Bureau of Mines.

Mr. Volin is Chief of the Mining Division, U. S. Bureau of Mines for Region 2, and he and his staff deserve to share equally in whatever credit is due the Field Team.

A. E. WEISSENBORN

Executive Officer
DMEA Field Team, Region II
Spokane, Wash.



Custom designed continuous automatic Dustube Collector filtering 25,000 c.f.m. gases from a Dwight-Lloyd Sintering Machine at the New Jersey Zinc Company, Empire Zinc Division, Canon City, Colo.

4 reasons why **DUSTUBE® collectors** *are your best buy*

1. UNIFORM RECOVERIES APPROACHING 100%

of the fume entering the Dustube cloth type collector are commonplace. It is the most dependable method of dust removal that will insure a "clean stack" under wide variation in operating conditions.

2. HANDLES HOT, CORROSIVE GASES

A fundamental approach to cooling equipment design plus a wide selection of filter fabrics, including new synthetics, has increased the scope of cloth filtration. Gas at initial temperatures as high as 2000° F. can be economically cooled and filtered at temperatures well above the dew point.

3. RUGGED SIMPLICITY, ECONOMICAL OPERATION

Dustube Collectors have the inherent capacity for continuous, severe service with a minimum of down time. Automatic units can be designed to permit interior inspection and maintenance without shutting down. Capital investment and operating costs are very reasonable.

4. APPLICATION ENGINEERED

Dustube Collectors are available in either standard units or they can be individually designed to fit existing or new plant buildings and flue lines. Collected material can be automatically discharged and conveyed to a common point for reprocessing without dewatering, filtering or drying.

NEW *40 page catalog*

contains practical charts and useful engineering data. Write today for your free copy of Catalog 72-B.

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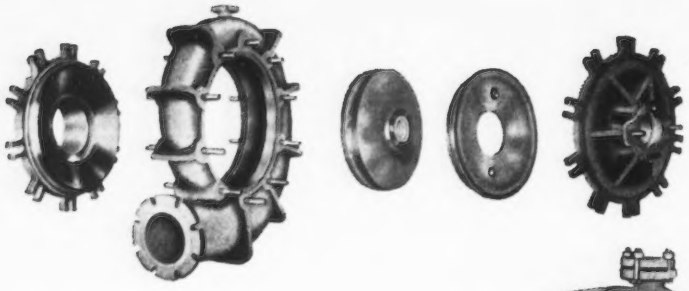
WHEELABRATOR & EQUIPMENT CORP.
438 S. Byrkit St., Mishawaka Ind.

dustube®
COLLECTORS



Nickel-Chromium White Iron is utilized to provide abrasion-resisting components for all GIW slurry pumps. Capacities of these units range from 50 to 8000 gallons per minute against heads up to 150 feet.

How slurry pumps defeat abrasion

...Give maximum life per dollar invested

The outstanding performance of pumps engineered and manufactured by the GEORGIA IRON WORKS CO., Augusta, Georgia, demonstrates the superior wear resistance of their GASITE® – a nickel-chromium white iron with high hardness and exceptional resistance to abrasion...

GIW slurry pumps are especially designed to utilize this long wearing nickel alloyed white iron as a means of increasing unit efficiency and cutting maintenance costs.

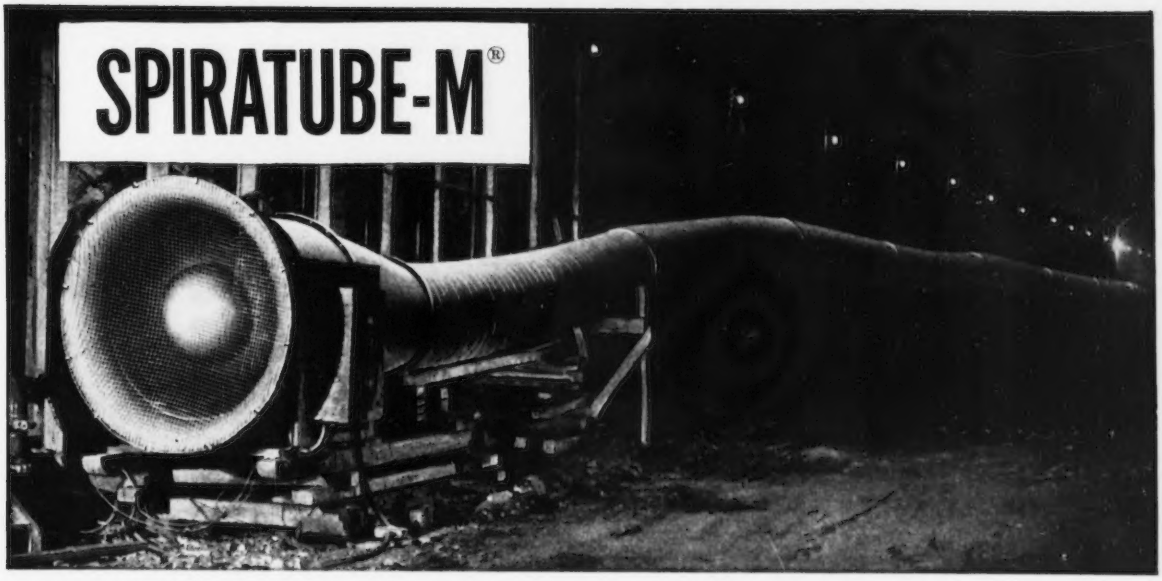
Users of these pumps maintain steady output and thus avoid the production losses and other expenses that follow shutdowns for replacement or repairs.

In all sorts of applications, nickel alloyed irons and steels prove their superiority day after day. Consult us on the advantages they can provide in your products or equipment. Whatever your industry, when you have a metal problem send us the details for our suggestions.

At the present time, nickel is available for end uses in defense and defense-supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

INCO

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.



Simplify mine and tunnel ventilation

Here's the airduct that can take it! Now you can deliver air to the working face of mine or tunnel — cheaper! That's because SPIRATUBE-M is built to cut maintenance costs! Ease of handling reduces installation costs. Unique SPIRATUBE-M construction features minimize leaks and seepage. And you get the maximum efficiency of your blower or fan . . . cutting power costs!

Immediately available in diameters to 30 inches, from fully-stocked distributors, SPIRATUBE-M is made in tough high count fabrics, all specially treated and heavily coated inside and out to withstand fungus, mildew and rough treatment.

And, patented, *built-in*, quick-couplers eliminate the need for separate parts . . . no need to look for couplers when you're in a hurry.

For heavy duty, pressure ventilation tubing without wire reinforcement, ask for AYRTUBE®. Sold in diameters to 36", AYRTUBE by itself or in combination with SPIRATUBE-M offers you an inexpensive airducting.

Check these features:

Handling ease

Lightweight

Flexible

Easily installed by you

Takes sharp turns without crimping

Withstands fungus, mildew, rough treatment

Flexible Tubing
CORPORATION

Guilford, Connecticut • Pasadena 1, California

FREE BOOKLET DESCRIBES SPIRATUBE-M and AYRTUBE MINING AND CONSTRUCTION APPLICATIONS. Write for your copy today.

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Send me your SPIRATUBE-M Booklet

Name _____ **Title** _____

Company _____

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Speeding up with products of United

This is a U. S. Giant® Style XN Conveyor Belt—one of the tireless workhorses you'll find throughout the Mesabi Range. The excellent troughability is created by using Nylon in the transverse direction of the belt. This "U. S." Belt always trains easily, runs true, eliminates spillage.

LIKE all new developments, Taconite brings new problems for the mining companies—new problems for the manufacturers who must supply them with the right tools for the job.

United States Rubber Company has always been a pioneer in supplying materials for iron mining. The new Taconite processors can rely confidently on the fact that "U. S." will fulfill its requirements just as completely and faithfully.

Shown here are a few of the many products "U. S." makes for the iron mining industry. Each item is a *quality* product—the result of careful thinking and intensive work by "U. S." engineers who are specialists in the mining field. One example of "U. S." pioneering is the new U. S. Tailing Hose specially designed to handle iron ore tailings. In every instance, the goal of each of these products is to cut operating costs and thereby enable the operator to attain a good competitive position.

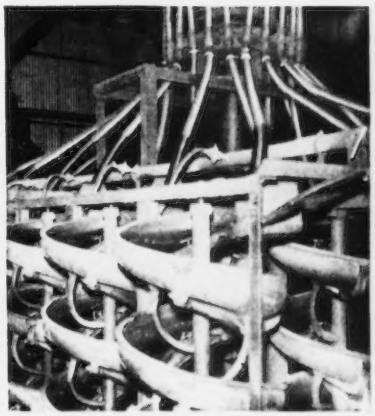
Leading mine officials can cut costs right from the start by buying from one source—and save time and trouble in the bargain. For fast, dependable delivery of United States Rubber Company products for the iron mining industry, order from your distributor or get in touch with one of the 25 "U. S." District Sales Offices.

Have you investigated the "U. S." three-way Engineering Plan? In three-way engineering, "U. S." engineers work hand in hand with the designers of the conveyor system and the engineers of the mine. This is a positive, fool-proof way of obtaining the *right* belt construction for the particular job.

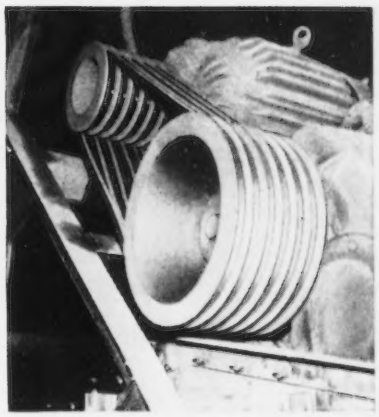
Iron Ore Mining

States Rubber Company

Ustex-Nylon belt by U. S. Rubber, installed on the Mesabi Range. 2,200 feet of this belt replaced 2½ miles of railroad track.

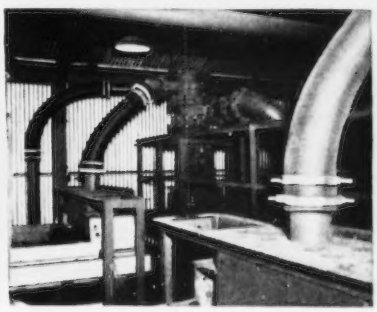


"U. S." small diameter hose and tubing play an indispensable part in iron ore separation. Above photo shows a section of a Humphrey Spiral equipped with "U. S." hose and tubing.

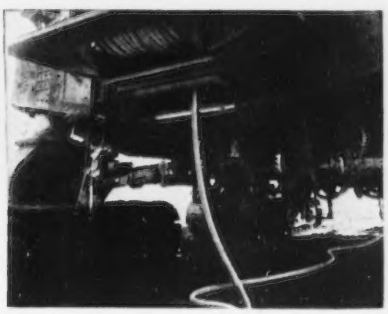


Matched set of six U. S. Rainbow® V-Belts which transmit power to a vibrating screen separator. These belts must withstand great shock loads from the vibrating action and must resist the action of abrasive particles which would damage ordinary belts.

U. S. Tailing Hose is designed as a flexible connection between the hopper and the metal pipe that conveys tailings to the processing plant. This hose withstands the abrasive action of the tailings, the high working pressures and the extremes of weather encountered all year 'round on the Mesabi Range.



U. S. Pilot® Flexible Pipe can run in a direct line from coupling to coupling—no need for elbows or short connections. Readily compensates for misalignment of pipe line and pump connection. Can be installed by unskilled crew in one-quarter the time for metal pipe, lasts far longer, weighs less. Will carry corrosive chemicals and solids such as Taconite, iron, coal and sand when suspended in water.



U. S. Royal® Shovel Cables are insulated with a high-grade rubber compound, and the conductor assembly is protected by a 60% neoprene sheath, vulcanized in lead for maximum density and ruggedness. Seven grueling laboratory tests, each of them tougher than actual conditions, guarantee U. S. Royal's resistance to moisture, abrasion, cutting, heat, cold, impact, flexing.

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SERVING THROUGH SCIENCE

"U.S." Research perfects it *"U.S." Production builds it* *U.S. Industry depends on it*

UNITED STATES RUBBER COMPANY

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Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes
Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

NOW! THE TOUGHEST SHOT FIRING CABLE EVER PRODUCED!

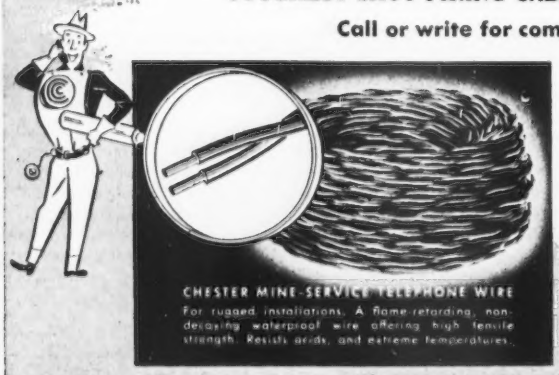
Check the long life qualities offered by this *SUPER DURABLE* **SHOT FIRING CABLE**

- RESISTS SHARP EDGES AND ABRASION
- FLAME RETARDING AND WATERPROOF
- NON-DECAYING AND NON-AGING
- HIGH STRENGTH AND FLEXIBILITY
- NON-CRACKING FROM −40°C to +80°C
- RESISTS MOST ALKALIS, ACIDS, OILS, GREASES
- IMMUNE TO OZONE AND SUNLIGHT

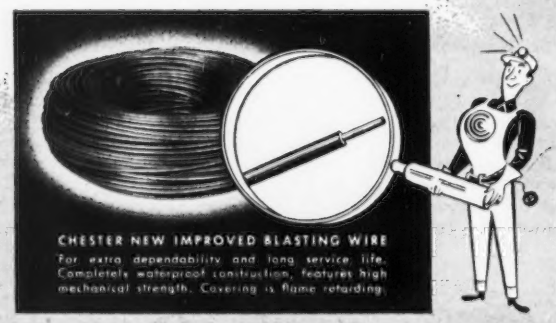
Exclusive CHESTER nylon jacket over center core increases service life and promotes mine safety

Here's the shot firing cable you can depend on for really tough mine service. It's highly durable when exposed to sunlight and ozone, withstands dragging over sharp edges and abrasives and is highly flexible. Non-cracking over a wide temperature range, Chester is flame retarding and waterproof—the kind of cable that's good for years of usefulness in all types of mining operations. Ask for Chester the next time you order — you'll agree, IT'S THE TOUGHEST SHOT FIRING CABLE EVER MADE!

Call or write for complete data and samples



CHESTER MINE-SERVICE TELEPHONE WIRE
For rugged installations. A flame-retarding, non-decaying waterproof wire offering high tensile strength. Resists acids, and extreme temperatures.



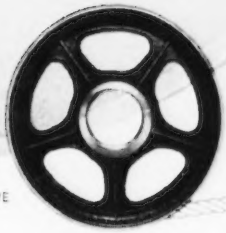
CHESTER NEW IMPROVED BLASTING WIRE
For extra dependability and long service life. Completely waterproof construction, features high mechanical strength. Covering is flame retarding.

CHESTER CABLE CORP.
CHESTER, NEW YORK

MANUFACTURERS OF QUALITY WIRES AND CABLES FOR EVERY INDUSTRIAL AND COMMERCIAL APPLICATION

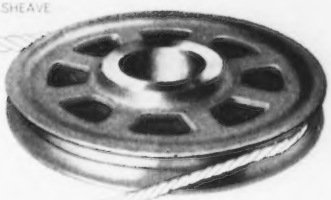
AMSCO

manganese steel sheaves extend wire rope life



OIL WELL SHEAVE

LADLE CRANE HOIST SHEAVE

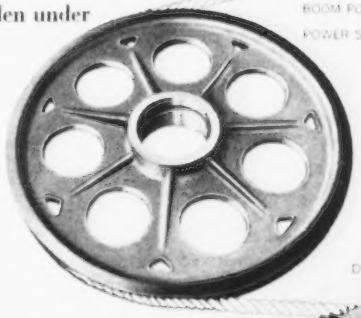


Wire rope replacements often cost more than the Amsco Sheaves that can minimize them.

Amsco Manganese Steel Sheaves work-harden under repeated impact and pressure, acquiring a polish that eliminates splintering. And because Manganese Steel Sheaves have high abrasion resistance they don't score.

Amsco Sheaves may be designed as single or double wall. The Double wall is particularly suited for applications involving extreme thrust.

BOOM POINT SHEAVE FOR POWER SHOVEL OR DRAGLINE



DOUBLE WALL SHEAVE

Cross section of an Amsco oil well sheave showing standard A.P.I. flange design.

Cross section of one type of Amsco Manganese Steel Sheave for industrial application.

Here is why Amsco Manganese Steel is called "the toughest steel known."

1. 12 to 14 percent Manganese
2. Work-hardens under impact to as high as 450-550 Brinell
3. Surface polishes to reduce wear, minimize need for lubrication
4. Strength and ductility for toughness
5. Readily weldable.

Write for your copy of the Amsco Catalog sheet for further details.

AMERICAN MANGANESE STEEL DIVISION

AMERICAN Brake Shoe COMPANY

376 East 14th Street · Chicago Heights, Ill. OTHER PLANTS: NEW CASTLE, DEL., DENVER, OAKLAND, CAL., LOS ANGELES, ST. LOUIS. IN CANADA: JOLIETTE STEEL DIVISION, JOLIETTE, QUE. AMSCO WELDING PRODUCTS DISTRIBUTED IN CANADA BY CANADIAN LIQUID AIR CO., LTD.

MIDVALE CRAFTSMEN FORGE
GIANT SHAFTS FOR AMERICA'S NEWEST POWER

Pressure Vessels
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Seventy-five hundred tons of pressure under skilled hands . . . four weeks time . . . ten "soakings" for reheating . . . and a 513,000 pound ingot begins to take on the shape of a huge generator shaft. Heat treating, machining, testing and retesting follow in precision steps. The result . . . a masterpiece in steel for America's newest and largest dam . . . precision made by Midvale.

From furnace to finished product Midvale controls its quality throughout. Huge forgings, weldless gear rings, press cylinders, pressure vessels, hardened and ground steel rolls . . . Midvale makes them all. Modern equipment, complete facilities, skilled and experienced men assure you of products to your most exacting, precision specifications.

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MIDVALE
Custom Steel Makers to Industry
PRODUCERS OF FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS

In Mines and Quarries "EUCS"

HAUL MORE TONS AT LESS COST

Built for tough off-the-highway hauling, Rear-Dump and Bottom-Dump "Eucs" have stepped up production and cut hauling costs on hundreds of open pit mining and quarry operations.

Euclids have proved their efficiency and long life in hauling a wide variety of materials . . . coal, ore, rock, overburden and other heavy excavation. Bottom-Dumps are powered by diesel engines of 190 to 300 h.p. . . . loaded speeds up to 34.4 m.p.h. . . . available in 20 to 40-ton capacities. Rear-Dump "Eucs" have travel speeds up to 36.3 m.p.h. . . . powered by diesel engines of 125 to 400 h.p. . . . range in capacity from 10 to 34 tons.

Your Euclid Distributor has performance data on jobs similar to yours. Ask him for a Euclid hauling cost estimate — there's no cost or obligation.

The EUCLID ROAD MACHINERY Co. • CLEVELAND 17, OHIO
CABLE ADDRESS: YUKLID CODE: BENTLEY

Euclid Equipment

FOR MOVING EARTH, ROCK, COAL AND ORE

THREE MARION 93-M SHOVELS

Harvest "Rock Cotton" in Canada

Three MARION 93-M Diesel shovels working in asbestos pits of the Canadian Johns-Manville Company, Ltd., in northern Ontario get a real workout.

They are on around-the-clock schedules in land where the mercury can drop to 60 below. The digging is all solid rock.

Two of these diesel shovels load out waste rock on both sides of the fiber-laden serpentine rock which the third machine digs. Despite the rigors of weather and terrain, each MARION turns in impressive tonnage records.

The details about 93-M strength, power and stamina to handle big assignments may point the way to a happy solution of some excavating problem for you. Why not ask your nearest MARION representative today about 93-M Diesel and Ward-Leonard electric machines?

MARION POWER SHOVEL CO.
MARION, OHIO, U. S. A.

from 3/4 cu. yd. to 45 cu. yds.

OFFICES AND WAREHOUSES IN ALL PRINCIPAL CITIES

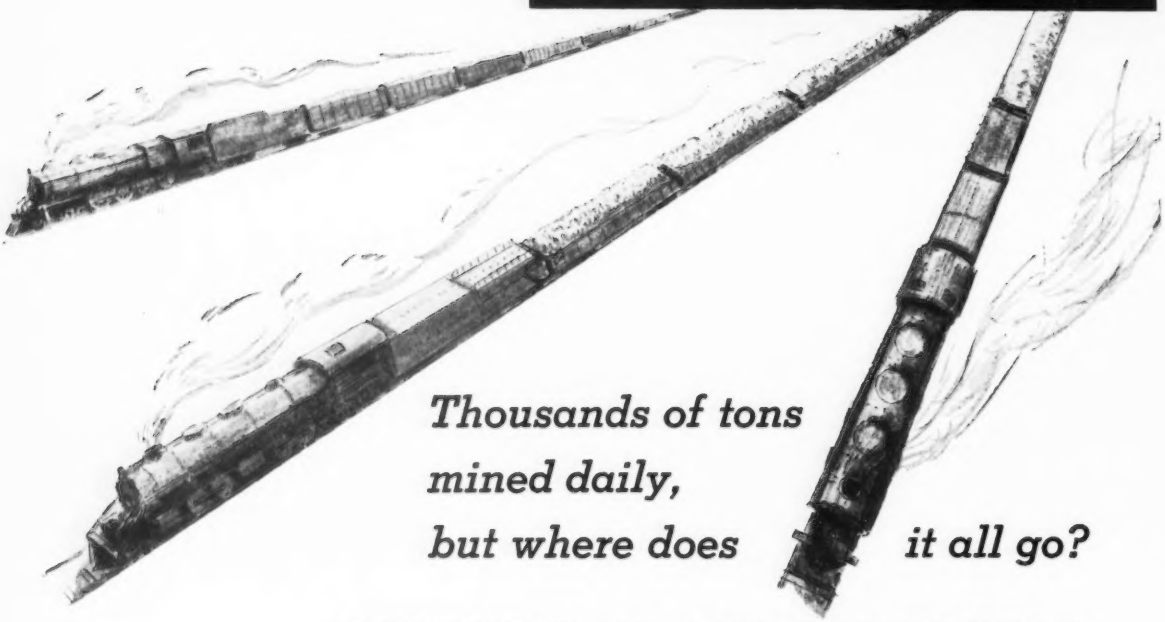
Wire Rope at Work — Perhaps the most unusual building of our time is the State Fair Arena at the State Fair Grounds, Raleigh, N. C., shown here while construction was in progress. Startling in design, this steel-and-concrete structure is some 300 ft long by 300 ft wide, with sides that rise gracefully in perfect arcs. But its most striking feature is the gently-curved roof, which is supported entirely by Bethlehem steel cables.

Forming a grid with 6-ft x 6-ft squares, the cables, zinc-coated for resistance to corrosion, are securely anchored to the framework of the building and are fastened together at points of intersection. Bolt-clipped to the grid are corrugated metal sheets which, with the topping, constitute the roof proper. This ingenious application of steel cable—a member of Bethlehem's wire rope family—has already aroused wide interest and may well suggest a new trend in design and construction.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation.

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:
MINING • CONSTRUCTION • PETROLEUM • EXCAVATING • QUARRYING • LOGGING • MANUFACTURING

Sulphur



Thousands of tons mined daily, but where does it all go?

LOOK AROUND YOU and let your glance fall on any object. The chances are 1000 to 1 that sulphur played an important role in its manufacture, either as a component part of the finished product or as a processing element.

Take, for example, the very magazine you are reading. If it's average size it weighs about 1 pound. Made largely of sulphite pulp it required about 0.1 pounds of sulphur in its manufacture.

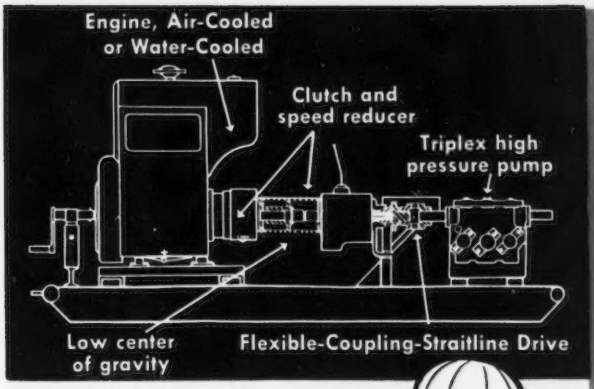
Multiply this 0.1 pounds of sulphur by the thousands of magazines turned out every day and you'll get some idea of the tremendous tonnage of sulphur required for this *single* division of industry . . . the sulphite pulp manufacture.

Sulphur has long been called One of the Four Pillars of Industry. Today's need emphasizes this fact more than ever. Sulphur producers are making every effort to get maximum production from existing mines and to develop new sources of sulphur as quickly as possible.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.

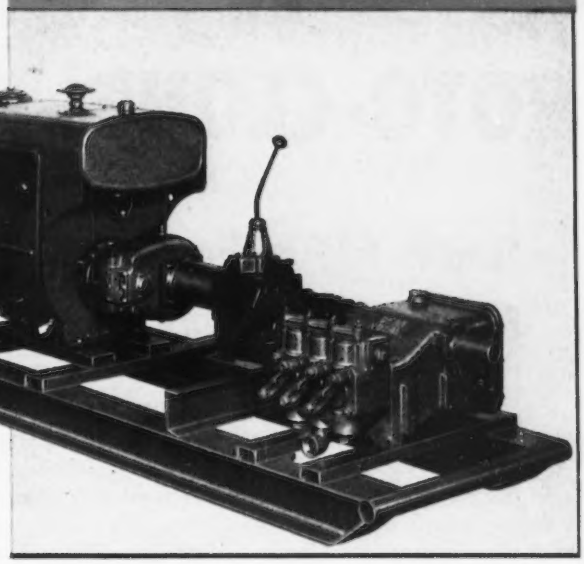
Mines: Newgulf and Moss Bluff, Texas



Longyear

420 and 435 TRIPLEX PUMPING UNITS

The Choice of Drill Operators for Dependability and Economy.



Better core recovery and lower diamond bit costs are assured with field operator designed Longyear Pumping Units. The simple ball-valve system and removable, steel-backed porcelain liners are designed for efficiency with low maintenance costs. Roller bearings and ball bearings on all load points make for smooth operation and long life. The three-speed transmission with throttle controls allows variable volume of almost any desired quantity. This assures better control by the operator. All water is pumped under a closed circuit and, therefore, all water goes into the drill hole. The Longyear 420 Unit delivers up to 20 gallons per minute at 500 p. s. i. and the Longyear 435 Unit up to 35 gallons per minute at 500 p. s. i.

Write us today—we would like to send you full details and specifications.

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CANADIAN LONGYEAR LTD.
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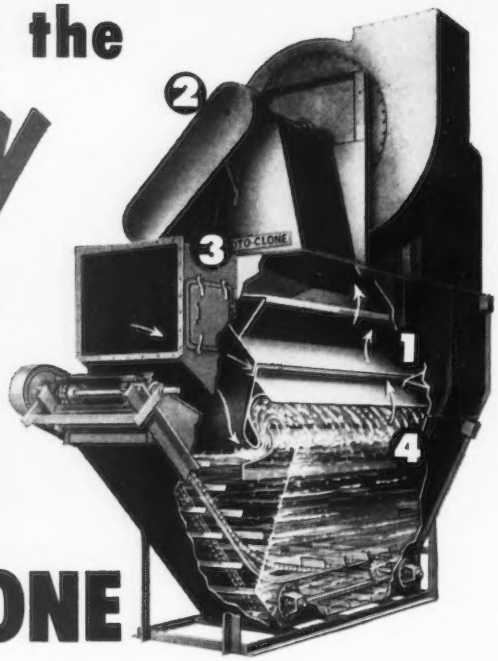
DIAMOND CORE DRILLS • CONTRACT CORE DRILLING
SHAFT SINKING • GEOLOGICAL INVESTIGATIONS
REPRESENTATIVES IN PRINCIPAL MINING CENTERS IN THE UNITED STATES AND OTHER COUNTRIES

Introducing the NEW DESIGN 4 TYPE N ROTO-CLONE



—1—

Improved and simplified entrainment separators further reduce Type N's low cost maintenance.

—2—

Addition of 4 larger sizes to permit handling of exhaust volumes up to 50,000 cfm.

—3—

Additional access doors with improved hinges.

—4—

Greater range in permissible water over-flow rate from control box.

Famous AAF Hydro-static Dust Collector Loaded with New Features That Reduce Maintenance, Add Life and Lower Cost

"The high dust collecting efficiency of the Type N ROTO-CLONE is written on the records of thousands of plants in scores of industries. Crushers, screens, conveyors, car dumps, roasters, kilns, coolers—all posed dust collection problems in the metallic and non-metallic industry until the addition of this product to the ROTO-CLONE line."

The new Design 4 Type N, while retaining the proven cleaning action of its inverted S-shape water curtain, now adds features to further reduce and simplify maintenance, increase service life and *lower cost*.

Check the features listed here. No Gadgets—just sound engineering improvements that save you money both on first cost and every day of operation. For complete information on the new Design 4 Type N ROTO-CLONE write for Bulletin No. 277B.

Plus ADDED FEATURES FOR EACH TYPE N ARRANGEMENT

Arrangement B (Manual Sludge Removal)

1 Sloping sides for easier, faster manual clean-out.

2 Lower section designed for ready conversion from manual to automatic sludge removal.

Arrangement C (Continuous Sludge Disposal)

Heavier sludge ejector chain with longer chain pitch and slower speed—designed for longer life of all sludge ejector parts.

Arrangement D (Continuous Sluicing)

1 New drain control equipped with regulating orifice; built-in flushing connection and lubricated plug valve.

2 New water-supply control, complete with pressure regulator, which automatically assures constant water supply.

You Can Expect the Best from

AAF

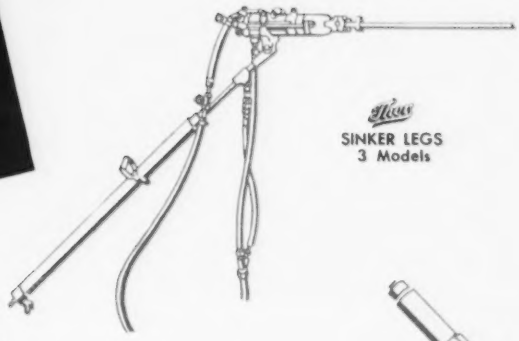
American Air Filter

COMPANY, INC.

193 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.

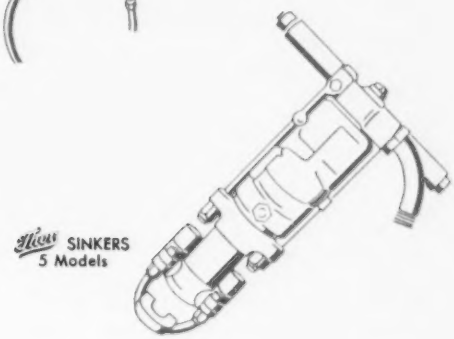
Reduce Mining Costs

with Thor ROCK DRILLS POWER FEEDS

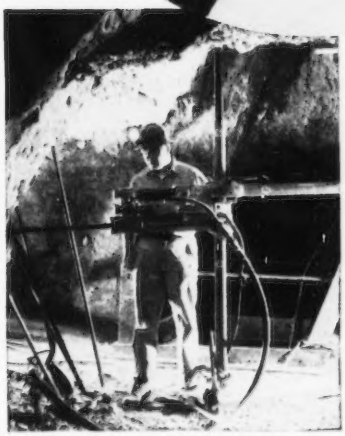


Thor SINKER LEGS
3 Models

No. 380
DRILLING
MACHINE



Thor SINKERS
5 Models



ABOVE, IN CIRCLE—No. 380 Drilling Machine with air-water backhead. 6 additional Sinker Leg models. IN SQUARE, Thor Air Bar Feed (4 models) and Thor Air Columns (3 models to 14 ft.).

BELOW: Thor Stopers, standard or reverse feed (6 models).

Thor POWER FEED DRIFTERS
3 Drill Sizes, 6 Shells to 60"+60"

For economies in blast-hole drilling, modernize with powerful Thor Rock Drills, supported and fed by the new Thor Power Feeds—developed for rapid set-up, quick steel change, and fast, low-cost drilling with carbide-tipped bits.

THOR ROCK DRILLS assure maximum use of your air power, plus long tool service and low maintenance costs.

THOR AUTOMATIC AIR FEEDS—air motors, air bars and air legs—provide maximum flexibility and power with complete safety and control.

WRITE FOR CATALOGS, INFORMATION OR DEMONSTRATION

THOR POWER TOOL COMPANY
AURORA, ILLINOIS

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Central America: Herramientas Thor de Mexico, S. A. de C. V., Basilio Badillo No. 47 Mexico, D. F. Mexico
South America: Thor Tool Hemisphere, Inc., Visconde do Parnahiba 1199, Caixa Postal 2899, Sao Paulo, Brazil
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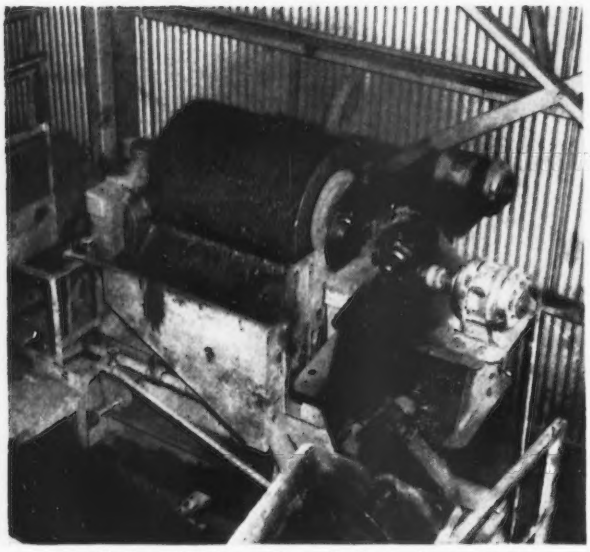
Thor PORTABLE POWER TOOLS

TOOL MAKERS FOR SIXTY YEARS

New Horizons in . . .

MAGNETIC SEPARATION



Installation of Jeffrey Magnetic Drum Separator in a Heavy Media plant treating iron ore.

JEFFREY

— is *pioneering* continuously in the modernization of wet magnetic separation processes.

— is *promoting* exclusively drum-type separators, simple, efficient, compact, dependable.

— *introduced* Jeffrey-Steffensen Counter-flow Separators for greatly improved iron ore concentration.

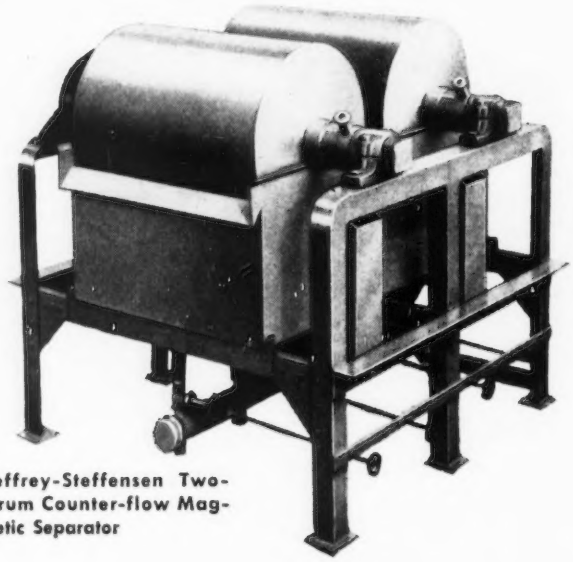
— *originated* Counter-flow units for the ultimate in recovery of magnetic medium in Heavy Media and Cyclone processes.

— is *looking ahead* by developing and improving magnetic equipment to meet the future needs of the mineral industries.

Jeffrey Magnetic Separators Excel

The Jeffrey-Steffensen Counter-flow Separator was scientifically developed on the job for unequaled production of slime-free, dewatered magnetic concentrate of highest possible grade, without the loss of valuable magnetics in the tailing. Available in one, two or three stages to meet the particular requirements of your concentration problem.

Send for descriptive literature and technical performance data.



Jeffrey-Steffensen Two-Drum Counter-flow Magnetic Separator

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

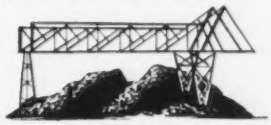
IF IT'S MINED, PROCESSED OR MOVED

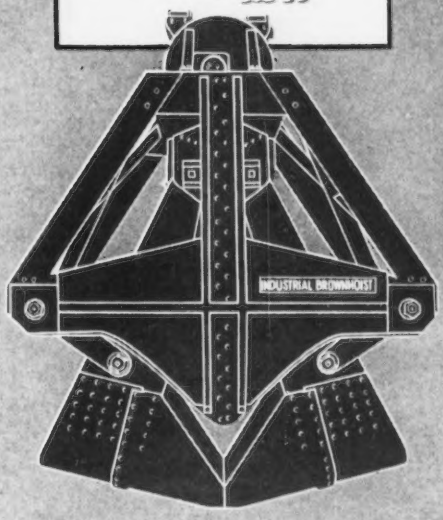
. . .IT'S A JOB FOR JEFFREY!

BROWNHOIST

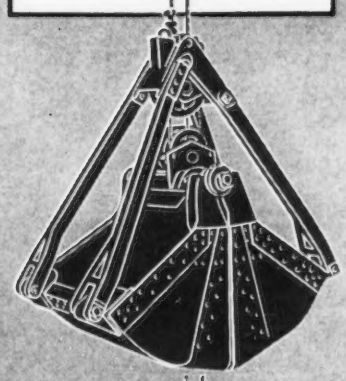
ALSO BUILDS BETTER BUCKETS

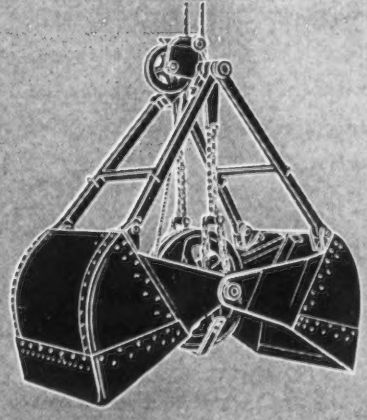
Link Type Buckets for boat unloaders, bridge cranes, fast plants





Rope Reeve and Power Wheel Buckets for locomotive cranes





Brownhoist Buckets are designed for specific jobs and especially engineered to meet the toughest materials handling requirements. They take deep, full capacity bites that move more materials per lift, thus making possible considerable savings in man-hours and production time. They are built for endurance and dependability, the same qualities that have accounted for Brownhoist leadership in the bulk materials handling field for more than three quarters of a century. Railroads, steel mills and dock operators who are loading and unloading coal, ore, slag or other bulk materials will find it pays to discuss their requirements with Brownhoist engineers.

BROWNHOIST builds better cranes

INDUSTRIAL BROWNHOIST CORPORATION • BAY CITY, MICHIGAN • DISTRICT OFFICES: New York, Philadelphia, Cleveland, San Francisco, Chicago; Canadian Brownhoist, Ltd., Montreal, Quebec • AGENCIES: Detroit, Birmingham, Houston, Los Angeles

When fine crystal rings true . . .

Eagle-Picher Lead Silicate and Lead Oxides give it the tone that stands for quality.

In fine glass manufacture—a unique combination of precision manufacture and artful inspiration —Eagle-Picher Lead Silicate and Lead Oxides impart distinctive character to the molten glass. This means that when the product is completed, it will have the dazzling sparkle, the perfect clarity and the bell-like tone that mark fine crystal.

The production of fine glass is but one of the many important applications where Eagle-Picher lead compounds serve well. There may be a use for these and other Eagle-Picher products in your own business. We'd like to talk it over.

EAGLE EP PICHER

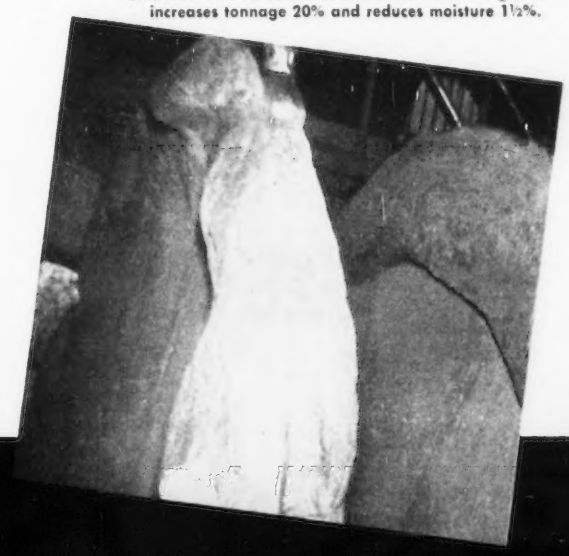
EAGLE-PICHER

Since 1843

The Eagle-Picher Company • General Offices: Cincinnati (1), Ohio

A good name on any product. Widely known as an important factor in mining, smelting and processing of lead and zinc, Eagle-Picher provides many products for essential uses in the paint, glass, ceramic, chemical and storage battery industries; in the manufacture of automotive and farm equipment and in many other fields: Slab zinc • Lead and zinc pigments and oxides • Molded and extruded rubber products • Diatomaceous earth products • Cadmium • The semi-rare metals: Gallium, Germanium. Mineral wool home and industrial insulations • Aluminum storm windows and screens.

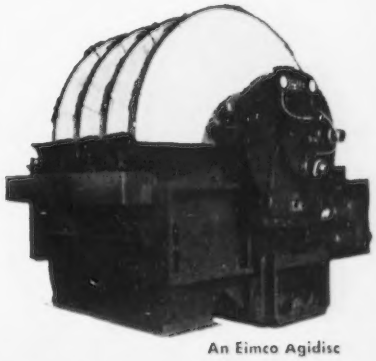
Above: Agidisc filtering copper concentrate. Below: Standard disc on same feed as filter above. Agidisc increases tonnage 20% and reduces moisture 1½%.



The Eimco Agidisc Filter for Continuous Vacuum Filtration of Metallurgical Slurries

These photographs show some of the important exclusive features offered in the Eimco Agidisc. Smooth, even, uniform cake formation in the two upper pictures which contrast with the typical standard disc filter with the heavy, lumpy build up of cake in the outside ring of the disc. (shown lower left.) The Agidisc with its uniformity of cake deposit, will make possible in your filtering station, higher capacity, lower moisture and longer bag life.

Our pilot plant will gladly run tests on your material and recommend size and type of filter to give you the best results. Write for information.



An Eimco Agidisc

EIMCO

AH77

THE EIMCO CORPORATION

The World's Leading Manufacturer of Vacuum Filtration Equipment

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Deadweight Down Payloads Up with

LAKE SHORE MINING EQUIPMENT

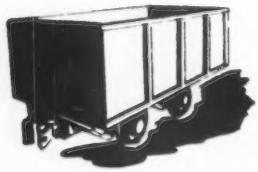
Skips and Cages—all types.

Sheaves—Roller Bearing, Rotating Shaft and Split Type Bicycle Sheaves . . . Cast Iron, Steel and Aluminum Idler Sheaves.

PRODUCTION INCREASES OF 8% and more have been recorded with the installation of Lake Shore engineered mining machinery, like the aluminum and steel Jeto Bottom Dump Skip (above). Lake Shore mining equipment is designed and built by men who know the field, men who know where and how to use weight-cutting aluminum, how to round the corners of tram car for greater rigidity and cleaner dumps . . . men who originated the roller bearing bicycle type head sheave and bell mouth idler sheave.

Lake Shore's experienced engineering is at your disposal either in existing models, or for the design of special machinery your operation may require.

Write today for free CATALOG 450-A.



Mine Cars—Lohed Tram Cars, Granby Type, Self-propelled Trestle Cars, Man Haul Cars.

101

LAKE SHORE Engineering Company

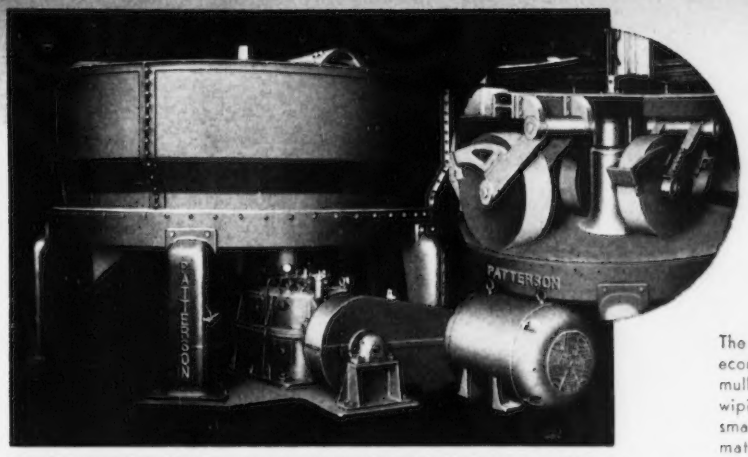
IRON MOUNTAIN MICHIGAN

Look to Lake Shore for Leadership

AGGLOMERATION--

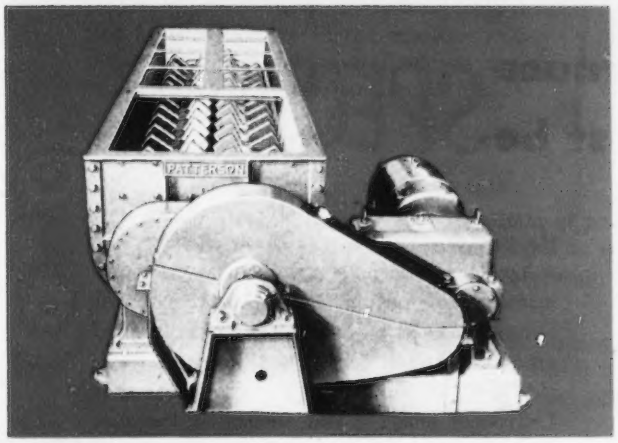
MEANS Patterson

- **FOR MODERN EQUIPMENT DESIGN!**
- **FOR BEST EQUIPMENT PERFORMANCE!**



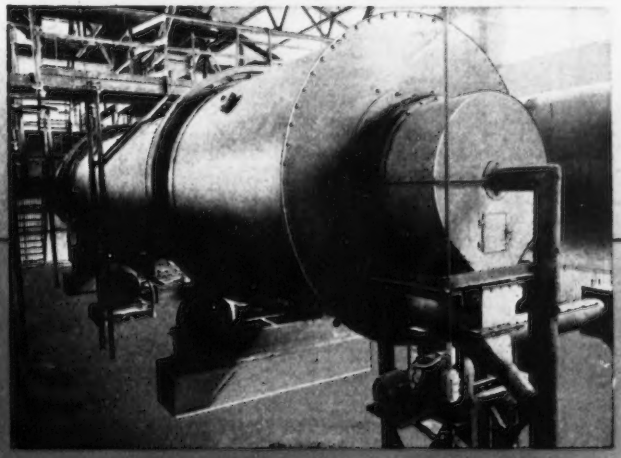
MULLING MIXERS

The Patterson Mulling Mixer is the primary unit for economical agglomerating. Equipped with wide-face mullers, it develops a highly effective kneading-smearing-wiping action. This unit is ideal for incorporating a small percentage of liquid in a large amount of dry material. As a plasticizing muller, it develops the working properties of the batch to fullest extent for subsequent forming.



TYPE GPM MIXERS
PROCESSING PUG MILLS

Heavy duty, twin-shaft horizontal mixers of extremely rugged construction. The counter-rotating intermeshing pug mill blades assure thorough blending, and the slicing action assures chemical treatment of every part of the batch. Patterson Processing Pug Mills are used to blend phosphate rock fines with water preparatory to plasticizing, for treatment of phosphate rock with phosphoric acid in the manufacture of super-phosphate fertilizer. It is suitable also for processing many other materials.



PELLETIZERS

Rotary type granulators and pelletizers, specially designed for thorough blending and granulating—assuring a uniform homogeneous product by complete blending of the coarse and fine material, as well as thorough distribution of the binder, if used. Spherical, free-flowing granules or pellets are produced, with a minimum of dust to separate in subsequent handling.

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East Liverpool, Ohio, U. S. A.

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The Patterson Foundry and Machine Company, (Canada) Limited
Toronto, Canada
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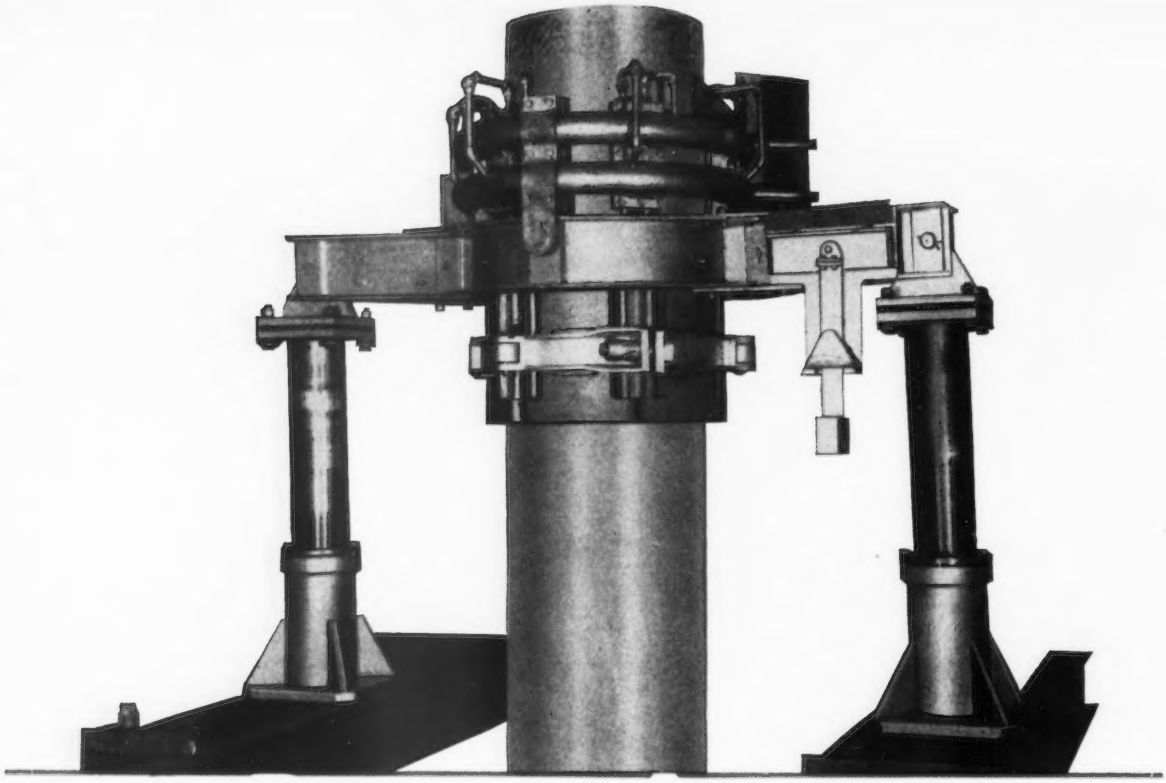


when your smelting furnace must be SPECIAL...

Lectromelt* Furnace engineers produced this hydraulic electrode lift to provide unobstructed space over a smelting furnace. "We must have free headroom," was our customer's specification.

The lift is self-leveling as it raises and lowers the giant 30-inch electrode. The special clamp, also produced by Lectromelt engineers, grips the electrode firmly and safely without harming the carbon. The Lectromelt assembly gave the customer exactly what he wanted.

You may have similar *special* furnace requirements. If so, you can be sure that Lectromelt Furnace engineers are qualified to design and produce the type of equipment you need.

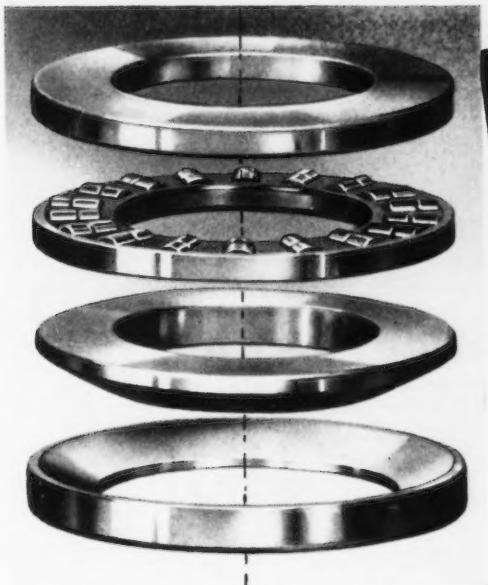
Write for Bulletin #105 which describes Lectromelt Smelting and Reduction Furnaces in detail. Pittsburgh Lectromelt Furnace Corp., 322 32nd Street, Pittsburgh 30, Pennsylvania.

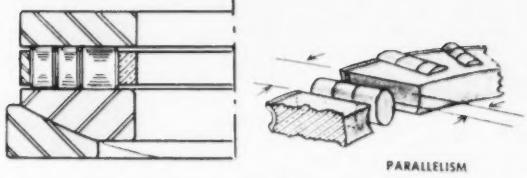
Manufactured In . . . CANADA: Lectromelt Furnaces of Canada, Ltd., Toronto 2 . . . ENGLAND: Birlec, Ltd., Birmingham . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Brassoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa. JAPAN: Daido Steel Co., Ltd., Nagoya

*REG. T. M. U. S. PAT. OFF.

MOORE RAPID

WHEN YOU MELT... *Lectromelt*





PARALLELISM

ACCURATE PARALLELISM between the rollers and the matched thrust plates is repeated in the parallelism between the separator slots and the rollers themselves—all adding up to quietness, equalized wear and longer life.

THRUST RADIAL

RIGHT ANGLE
Roller Ends, precisely square to avoid end-rub, oscillation and side-shock.

● RIGHT ANGLE
Bearing Surfaces with parallelism that results in unwavering right-line rolling.

● RIGHT ANGLE
Separator Slots accurately machined to prevent roller skew, slide and uneven wear.

Held to extremely close limits of parallelism, every roller—every race—every thrust plate in a Rollway Bearing is an engineering masterpiece of matched precision and right-angle trueness. As a result, friction losses are low—load capacity and service life high.

Rollway Radial and Thrust Bearings offer the widest selection in types and sizes, available for quick replacement through authorized distributors. Consult your classified phone directory under BEARINGS.

Our engineers are available without cost or obligation to assist you in selecting the correct Rollway Bearing for your needs. Call your nearest Rollway sales office, or write Rollway Bearing Co., Inc., Syracuse, N. Y.

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Complete Line of Radial and Thrust Cylindrical Roller Bearings

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Since 1856
Mines Equipment, Mineral Dressing Plants, Crushing and Grinding Machinery, Cement Mill Outfit, Metallurgical Works, Coal Preparation Plants, Steel Constructions for Buildings and Bridges.
DEUTZ
Since 1864
Otto Gas, Diesel-Engines for Every Purpose of Two- and Four-Stroke design, Output range 3 1500 H.P. Cooled by water or air, Diesel-powered tractors, Diesel locomotives, Gas producer plants
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Since 1864
Trucks and busses driven by air-cooled DEUTZ Diesel engines, Vehicles for municipal services, Fire ladders, fire engines, Fire fighting water trucks, Two-wheeled ladders, Fire fighting equipment.
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Send inquiries to either Köln, Germany or Ulm, Germany

Important facts about pH for MINING & MILL OPERATORS

WHETHER you are building a new plant or modernizing present equipment, one of the most important advancements you can make is the installation of BECKMAN pH CONTROL. Throughout the mining industry—in gold, tin, tungsten, lead, zinc, copper and many other flotation operations—Beckman pH Control is proving to be the key to much higher recoveries, better control of processes, lower labor and chemical costs. Result—substantially greater profits per ton of ore. Some of the many benefits resulting from Beckman pH Control include . . .

- greater speed, convenience and accuracy in laboratory leaching or flotation tests.
- opportunity for centralized or automatic, control of multiple flotation circuits.
- reduction of corrosion and scaling in pipe lines.
- improved or automatic, control of electrolytic operations.
- *and many other vital savings in mining and mill operations—savings that will quickly pay for the installation, and will continue producing extra profits year after year!*

TO MAKE CERTAIN you get the latest, most convenient and most accurate pH equipment, *be sure to specify* "BECKMAN" . . .

✻ Beckman pH equipment is completely electrometric, eliminating the mess and inaccuracies of colorimetric methods. Simply press a button and the exact pH of any process is instantly shown on a large easily-read dial. *It is the simplest of all pH methods!*

✻ With Beckman equipment no time-wasting or troublesome sampling devices are needed. Beckman pH electrodes may be installed directly in vats, tanks, channels or flow lines—and exact pH values read instantly —and *continuously*, if desired—on the process fluids themselves.

✻ The accuracy of Beckman pH readings is completely unaffected by human errors in color judgment, by turbidity, oxidizing or reducing agents, by suspended materials, colored process solutions or other variables that affect outmoded colorimetric methods. *Beckman pH readings are universally accurate and dependable!*

✻ Unique rugged-type Beckman Electrodes, especially designed for direct immersion in abrasive or suspension-laden fluids, reduce maintenance to an absolute minimum. *Beckman is the most trouble-free of all pH equipment!*

The above are only a few of many Beckman advantages. Write for the complete story.

There's a Beckman pH Instrument to meet your needs!

COMPLETELY AUTOMATIC! The Beckman Model R instrument operates directly from standard 110 v. A.C. lines to provide completely automatic pH indication. Also provides for completely automatic pH recording and automatic process control. Can be installed to give accurate pH readings from various stations in plant through one instrument. *This is the pH unit being installed by today's most modern plants, large and small.*

PORTABLE A.C. OPERATION! The Beckman Model H instrument can be quickly moved from one part of the plant to another and plugs directly into standard 110 v A.C. current. Compact, convenient and extremely simple to operate, the Model H gives *instant* pH readings on an easily-read dial. Widely used both for manual pH control of small plants and as an auxiliary instrument on completely automatic pH installations.

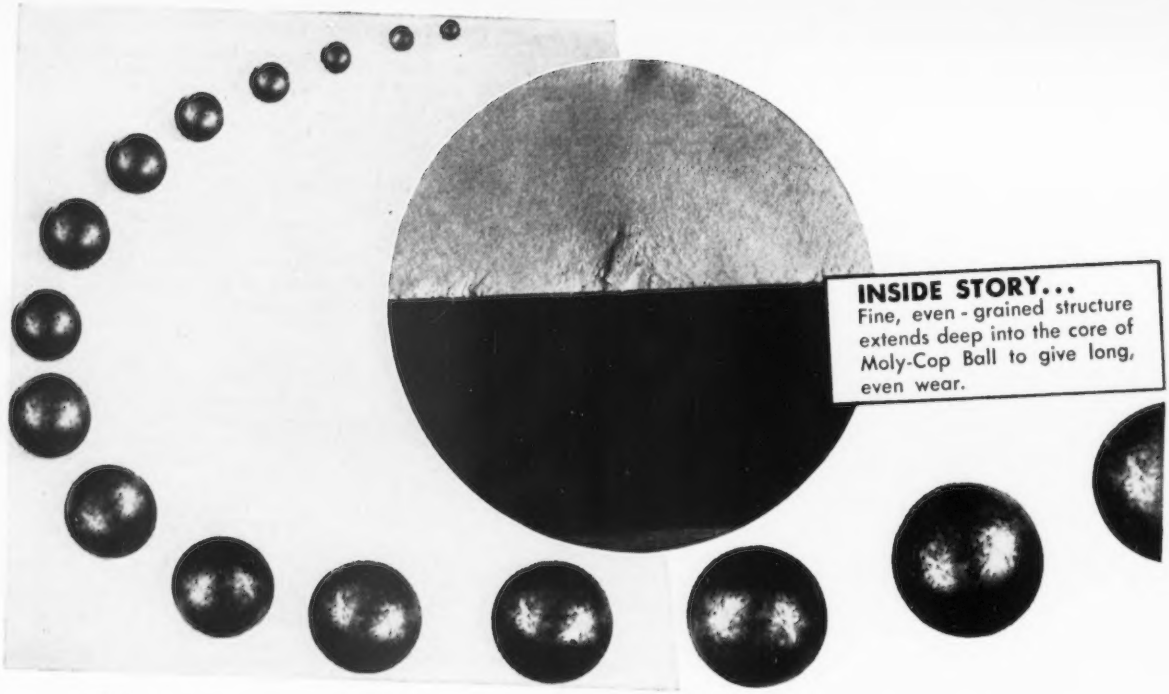
COMPLETELY SELF-CONTAINED! The Beckman Model N is the ideal instrument where *complete* portability is desired. Operating from its own self-contained, long-life power supply, the Model N can be used *anywhere*—in plant, field or laboratory—without dependence on A. C. power circuits. Features maximum compactness, simplicity and operating convenience, coupled with extreme ruggedness. Available in two types . . . the N-1 with separate Buffer, KCl solution and beaker . . . the N-2 with integral case for Buffer, KCl solution, beaker, thermometer, etc.

BRING YOUR pH PROBLEM TO US. Our trained engineers will gladly study your problem and recommend the equipment best suited to your particular requirements. No obligation, of course.

Write for literature on Beckman pH Equipment!

BECKMAN INSTRUMENTS, INC.

SOUTH PASADENA 27, CALIFORNIA



If you want a finer grind . . . use a finer ball!

SHEFFIELD MOLY-COP

TRADEMARK REG.

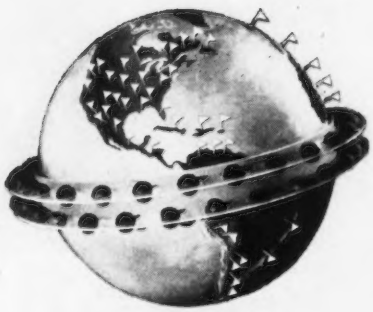
COPPER-MOLYBDENUM-ALLOY

Grinding Balls

For fine grinding you want a ball that will give you the highest possible production rate with the lowest cost per ton of material ground . . . fewer chargings, less "down time."

Sheffield Moly-Cop Balls meet that requirement — because Sheffield's exclusive alloy and automatically controlled manufacturing methods produce a ball of finer, denser, more uniform structure. You get toughness and greatest resistance to abrasion. Moly-Cop Balls wear evenly, retain their spherical shape longer.

Tests have proved that Moly-Cop Balls wear up to 35% longer than alloy cast steel balls; up to 50% longer than best quality unalloyed carbon forged steel; and up to 120% longer than cast white iron balls. Considering initial costs and length of service, the net savings that result from the use of Moly-Cop Balls are substantial.



Used and proved around the world--*Sheffield engineers* are ready to prove the money-saving advantages of Moly-Cop Grinding Balls in your operation. Get in touch with us now.

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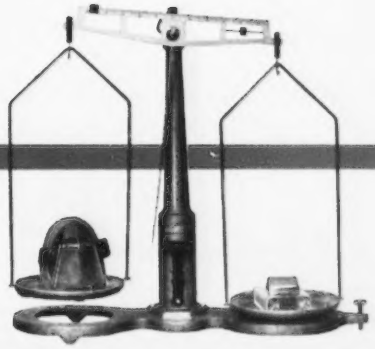
Export Representatives: ARMCO INTERNATIONAL CORPORATION, MIDDLETOWN, OHIO

Preferred by Miners because . . .

It's lighter in weight



It's more compact

It's comfortable

The M·S·A Dustfoe #55 Respirator

Set the Dustfoe #55 on a balance scale with a pack of cigarettes and a lighter—the Dustfoe is *outweighed*; put the Dustfoe in the palm of your hand—the size comparison gives you a good idea of its compactness; snap the Dustfoe into place—here's comfort that's a welcome change from the unbalanced, bulky feeling of old-fashioned respirators.

And light weight, compact comfort is only half the story. The M.S.A. Dustfoe #55 is U. S. Bureau of Mines Approved for breathing protection where dusts are not significantly more toxic than lead. Effective filtering action keeps miners on dust-producing operations safe, helps maintain production continuity by eliminating breathing discomfort.

Add them up, and you can see why the Dustfoe #55 is the *"Respirator Miners Will Wear!"*

Our bulletin gives complete details. Write for your copy, or better yet, call your nearest M.S.A. Representative for an actual demonstration.

MSA
SAFETY EQUIPMENT HEADQUARTERS

When you have a safety problem, M.S.A. is at your service. Our job is to help you.

MINE SAFETY APPLIANCES COMPANY
201 North Braddock Avenue, Pittsburgh 8, Pa.
At Your Service: 77 Branch Offices in the United States and Mexico

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M·S·A EQUIPMENT FOR DUST CONTROL

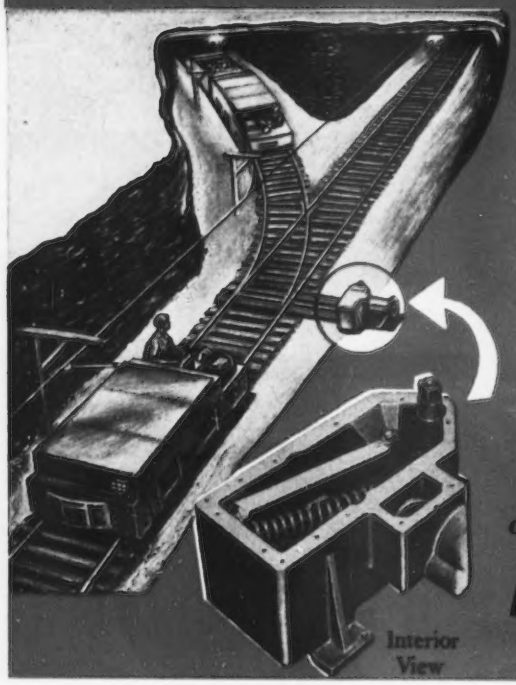
M.S.A. MIDGET IMPINGER

Compact, easy to use for accurate sampling of particulate matter. Samples at the rate of 1/10 cubic feet per minute. Portable, the unit is ideal for dust control and survey work in the mine.

M.S.A. DUST-VUE MICROPROJECTOR

Show collected dust particles magnified to 1000 times on ruled, translucent screen. Permits accurate, rapid counting and size determination. Relieves eye strain.

Electri-Throw—DEPENDABLE SWITCH THROWER



Interior View

SAVES LIVES—
...eliminates costly accidents

Greatest number of trips in a given time is accomplished by the "Canton" Automatic Switch Thrower. This eliminates stopping for switch to be thrown, saves labor, and *eliminates* that *accident potential.* For further safety, *signal lights show position of points,* if blocked or split. All *flashing* and *sparking at points* of contact with trolley wheel are *eliminated.* This unit is as nearly foolproof as is possible. Constructed on the solenoid principle in combination with patented automatic cutout, actuating mechanical connection to the Track Switch, instantly throwing the switch points against the rail on either side of track. Can be used as an automatic derailer, *protecting life and property* . . . operated usually by the motorman while traveling full speed ahead.

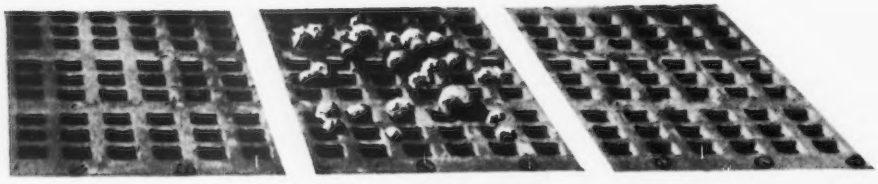
Write for complete descriptive catalog, using street and zone numbers.

Manufacturers • Safety Signal Systems • "Dustributors"
Automatic Doors • Car Transfers
Cable Splicers and Vulcanizers • New Mechanical Track Cleaners

American Mine Door Co.

2039 DUEBER AVENUE, CANTON 6, OHIO

Before... and... After...



the screen is the same

Hendrick Perforated Metal Plate assures a long life of service on vibrating and shaking screens. Available in any desired shape or size of perforations, it can also be supplied flat or corrugated in proper gauges of regular, high carbon, and high tensile steels and in other commercially rolled metals.

Full open clearance reduces blinding to an absolute minimum. Decks can be changed fast and easily, saving valuable time and labor costs. Write for more information.

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PERFORATED METAL • PERFORATED METAL SCREENS • WEDGE-SLOT SCREENS
ARCHITECTURAL GRILLES • MITCO OPEN STEEL FLOORING • SHUR-SITE TREADS • ARMORGRIDS

MORE STANDARD SIZES TO CHOOSE FROM

In the range from 1 to 400 horsepower JONES offers the most complete line of Herringbone Gear Speed Reducers available *ANYWHERE*.

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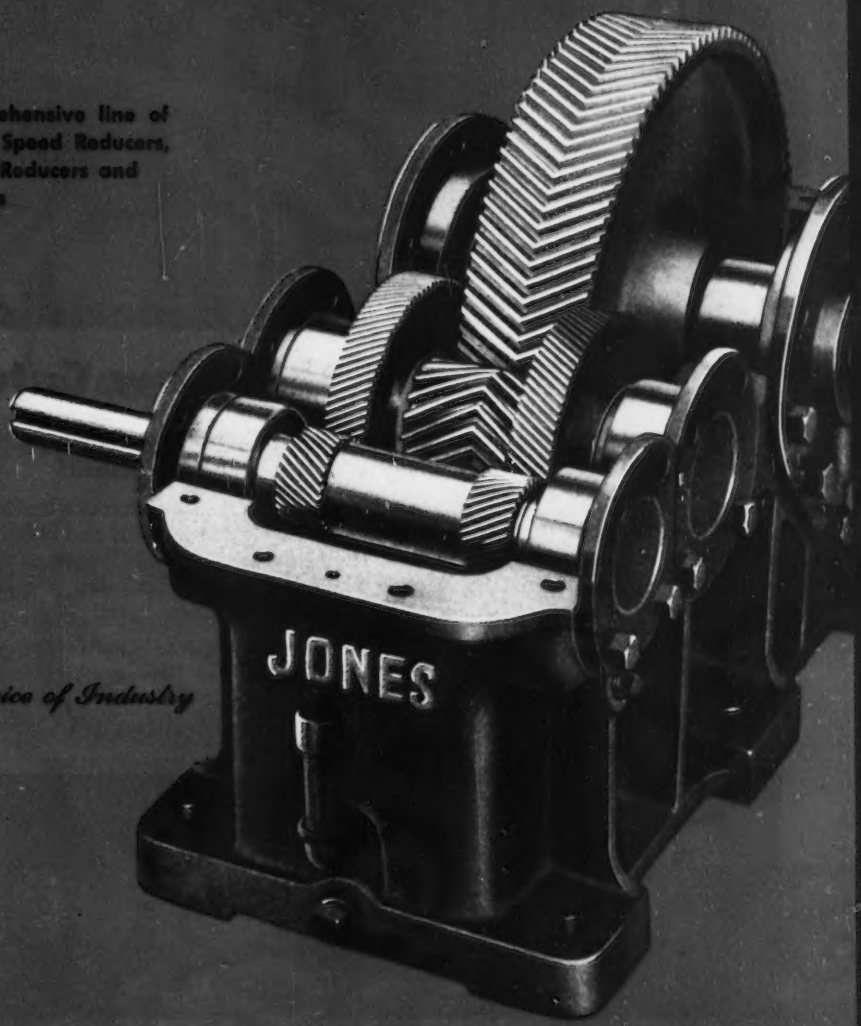
Manufacturers of a comprehensive line of quality Herringbone Gear Speed Reducers, Worm Helical Gear Speed Reducers and Worm Gear Speed Reducers



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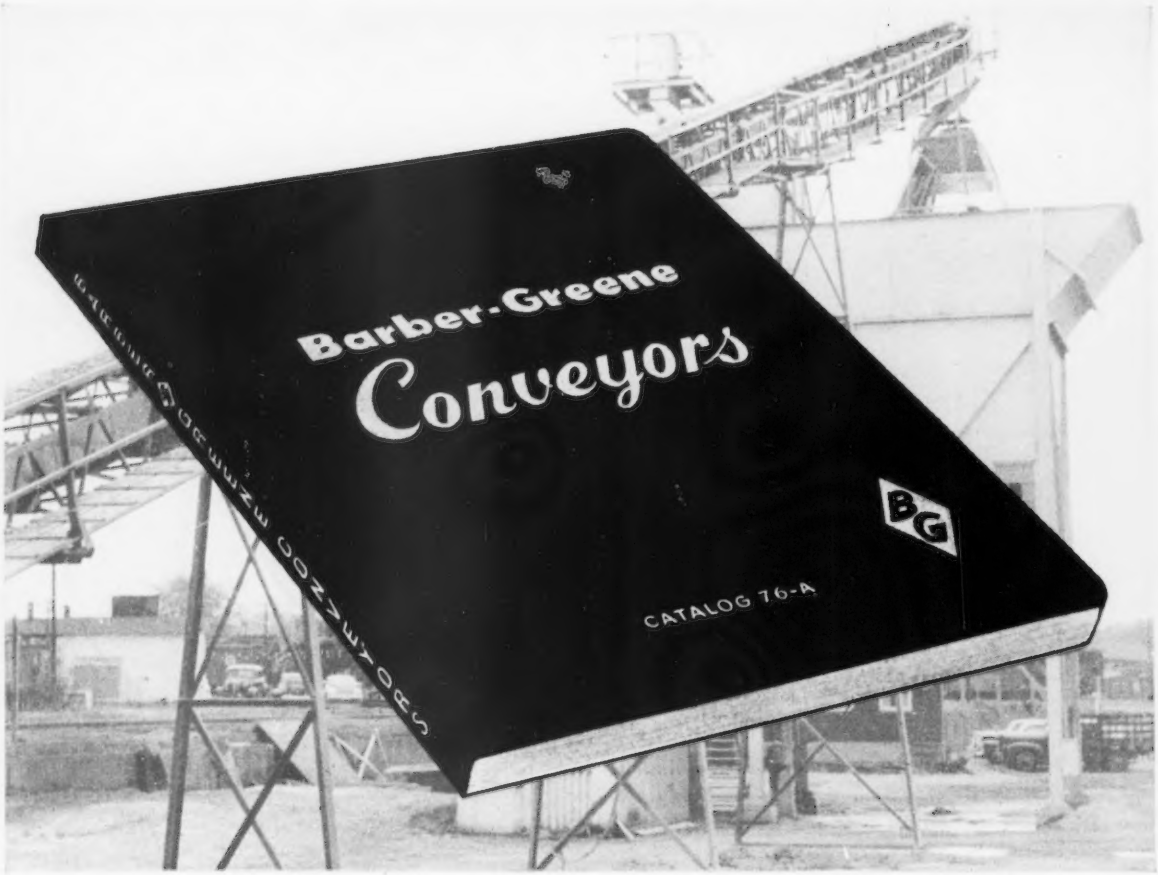

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Here's the Most Complete, Comprehensive, Easy-to-Use Conveyor Catalog Ever Published!

Clearly presented in this 192-page book is the broad selection of standardized drives, take-ups, truss, idlers, belting . . . all the components and accessories required to fit your requirements. There are more than 60 pages of typical conveyor layouts and installation photographs. Also included is a section on shuttle conveyors, stackers, feeders and portables.

This catalog clearly and factually demonstrates the savings in design, delivery time, erection and operating costs that Barber-Greene standardization makes possible. Once you use it, you'll have a new conception of the economy, utility and simplicity of Barber-Greene Standardized Conveyors.

WRITE FOR YOUR COPY

If you handle bulk materials, you'll want this new catalog. Please request Catalog 76-A on your company letterhead.

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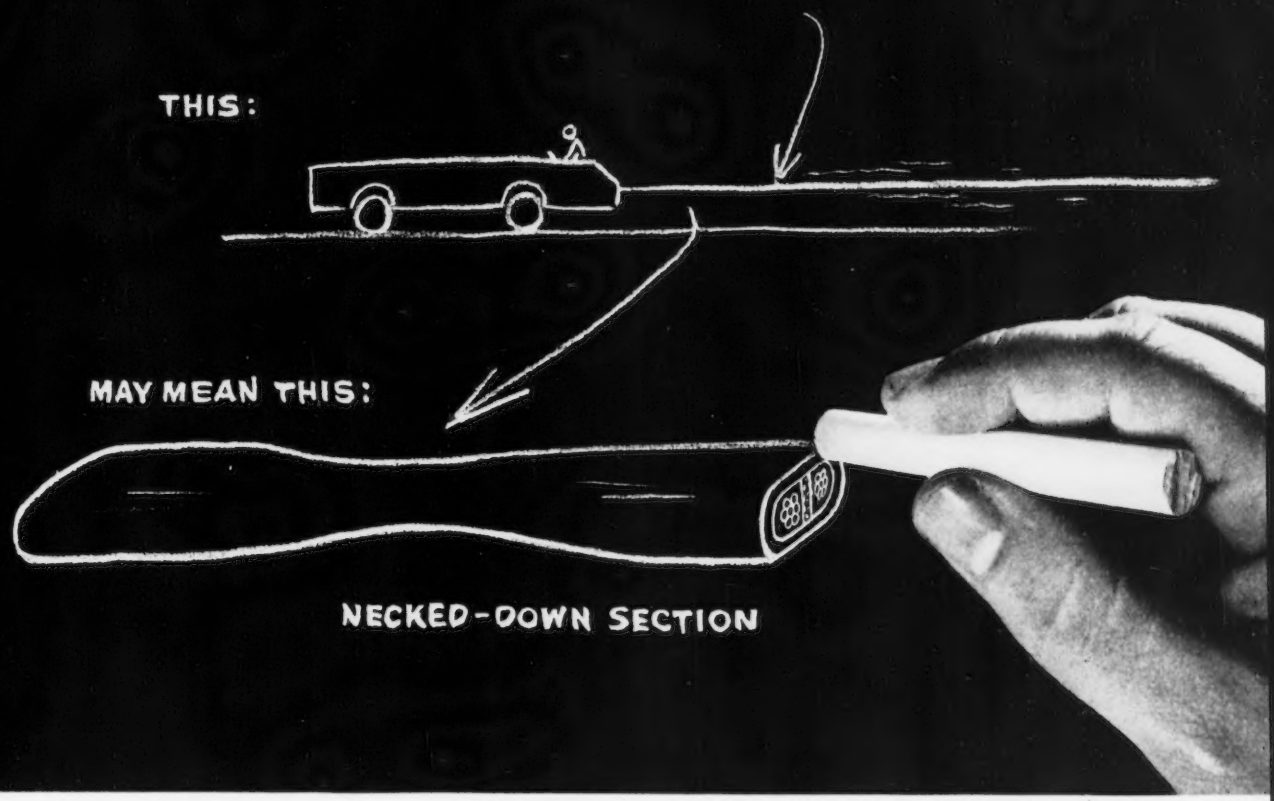
Barber-Greene BG

Aurora, Illinois, U. S. A.

MINING MACHINE CABLE

HOW TO SPOT DAMAGE FROM TOO MUCH TENSION



. . . AND WHY ANACONDA'S NEW BALANCED DESIGN ADDS SAFETY, LONGER LIFE TO CABLE

Necked-down cable shows overstretching. Jacket and insulation become thin, easily punctured. Moisture penetration or a broken ground conductor may make the cable hazardous.

ANACONDA'S ANSWER: BALANCED DESIGN

Tension devices help; but aren't cure-alls. An added safeguard lies in the balanced design of Anaconda's new mining-machine cable. Stretchability of the ground has been increased. It will not break before the power conductors. A new neoprene jacket has higher compression-cutting resistance and tensile strength. In the insulation more strength and moisture resistance are obtained from a cold-rubber base . . . similar to that used by tire makers to mold a tougher tire. Stranding, too, has been redesigned to make the whole cable more flexible . . . at no greater cost. You get less trouble from tearing, cutting, gouging and abrasion caused by rib-pinching, runovers and dragging.

MUCH LONGER AVERAGE LIFE

In shuttle cars recently surveyed in 15 mines, ANACONDA Cables last 3 times as long as cables made only a few years ago. To learn why this is so, ask your nearest Anaconda Sales Office or Distributor for a sample section of this new cable. Examine it . . . take it apart. And remember that no ANACONDA Mine Cable has ever failed a U. S. Bureau of Mines flame test. *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

ANACONDA®

TODAY'S HEADQUARTERS FOR MINE CABLE

FLAT-TWIN CABLES FOR:
shuttle cars
continuous miners
loaders cutters
drill trucks

HI-VOLT CABLES FOR:
mine power

TYPE SH-D FOR:
shovels

TYPE SO FOR:
hand drills
remote control

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FEEDER CABLES
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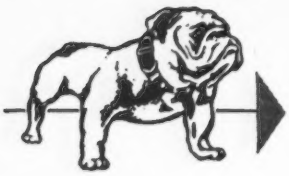
SHOT FIRE CORD
WELDING CABLES



Mack comes in costs go down

It happens all the time. A truck user finds that heavy loads, rigorous weather, or tough terrain are proving too much for the trucks he owns. Frequent breakdowns . . . interrupted output . . . excessive repairs—all conspire to boost his costs and cut his profit margin. Then—if he's smart—he switches to Mack six-wheelers.

And that's where he gets a real eye-opener. Because even under the most adverse hauling conditions—hub-deep mud, slippery sand or pitted rock-strewn ground—his Mack six-wheelers keep the big loads moving on dependable, time-saving, cost-cutting schedule.

The reason why? It's found in Mack's Balanced Bogie with exclusive Power Divider that assures positive traction no matter how tough the going. Acting normally as a true differential the Mack Power Divider delivers torque between the two bogie axles in proportion to wheel traction, thus eliminating useless wheel slippage and spinning.

Mack's Balanced Bogie and Power Divider combine with numerous other outstanding Mack features to give you the power, strength, traction and easy maintenance you need to handle the biggest loads—with greater profit to you. Your nearest Mack branch or distributor will gladly give you all the facts.

Mack TRUCKS

. . . outlast them all

Mack Trucks, Empire State Building, New York 1, N. Y. Factory branches and distributors in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

In tough mining and quarry operations, owners who switch to Macks consistently find that these rugged trucks are the answer to more dependable service.

"Handiest piece of surface equipment we have at the mine"

Says A. J. Zinkl, Ass't. Mgr.

Iron King Mine and Mill near Humboldt, Arizona, property of the Shattuck Denn Mining Corp., is one of the most important lead-zinc producers in the west. To handle all kinds of construction and erection, they selected a 10-ton Lorain Self-Propelled crane, model SP-152. Here it is shown handling ½" steel sheets, size 4' x 12', used to build thickener tanks at the mill. But that is only one of many uses. Their Lorain handles mine timbers, unloads steel from cars, sets machinery, travels from one end of the extensive mine operation to the other to do 'most any job where lifting, loading, excavating, erection or material handling is involved. That's why A. J. Zinkl, Assistant Manager, says this rubber-tire "Jack-of-all-trades" is the handiest of all surface equipment at Iron King Mine.

SHATTUCK DENN MINING CORP.

get these advantages from their Lorain Self-Propelled crane performance . . . to travel to mine or mill, to serve a wide area of their operation, to go places fast and to get to work in a hurry.

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- UNLIMITED MOBILITY. Materials move when and where you need them — there's hardly a limit to the work areas you can serve.
- HANDLE MANY MATERIALS. You can fit your Lorain crane with more than 16 lifting attachments, to handle any size, shape or type of material.
- A WIDE SELECTION. Lorains on rubber range in capacities from 6 to 45 tons — with a choice of 4 or 6 wheel drive arrangements, Self-Propelled or Moto-Crane types. Also, crawler mountings available.

Ask your Thew-Lorain Distributor for more facts to fit your mine needs.

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LORAIN, OHIO

MINING MEN PREFER THE NAME

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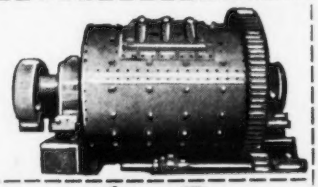
Completely assembled in our shop, then marked and knocked down for shipping "Anywhere a Mule Can Go."



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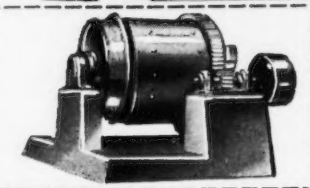
Most economical type. Particularly suited to amalgamating and concentrating classes of ores. Capacity from 2 to 95 tons per 24 hours.



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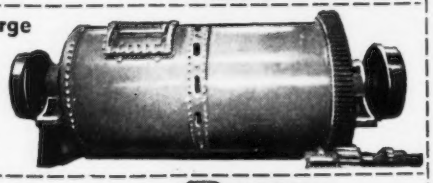
Particularly suitable for producing a granular product. Designed for controlled grinding of tungsten and similar ores where sliming must be eliminated.



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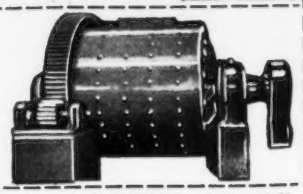
One of the new Champion Series. Available in low pulp line, plain overflow, screening and convertible types with capacities ranging from 25 to 250 tons per 24 hours.



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VERSICON Hose is built to last. Synthetic oil-proof tube is reinforced with braided, high-tensile rayon. Tough oil-proof cover resists weather and abrasion.

For quick, easy identification, VERSICON has a brown cover. It's available in sizes from $\frac{3}{16}$" to $1\frac{1}{2}$" in lengths to fit your requirements.

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Metallurgical Efficiency

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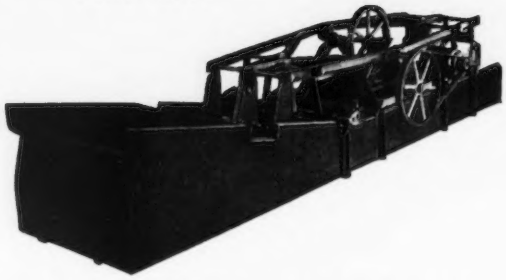

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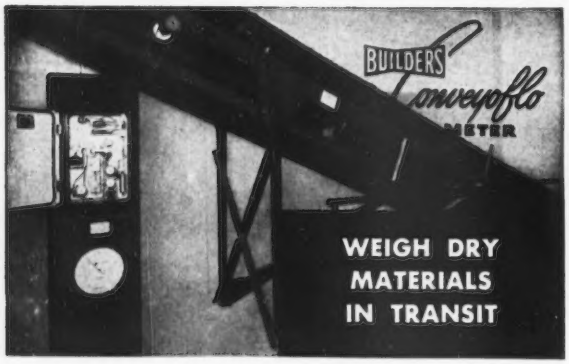

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EXCLUSIVE FEATURES:

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Write for Bulletin 550-H4, giving complete details. Builders-Providence, Inc. (Division of B-I-F Industries), 391 Harris Ave., Providence 1, R. I.

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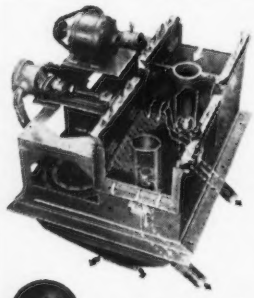

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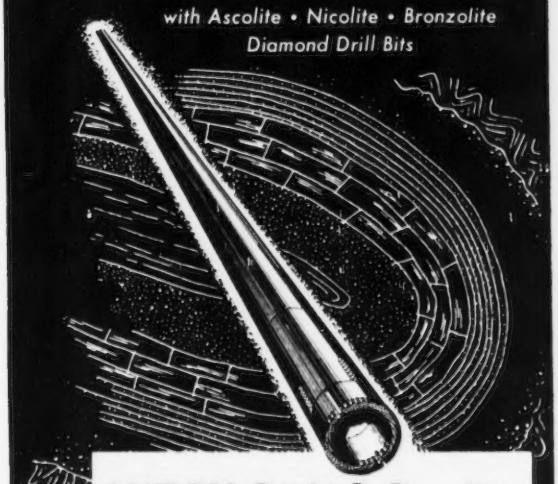

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1—21x10 C P Vacuum Pump, Model 0IDB
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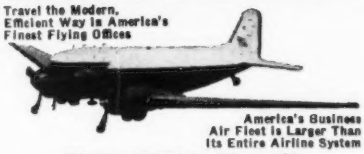

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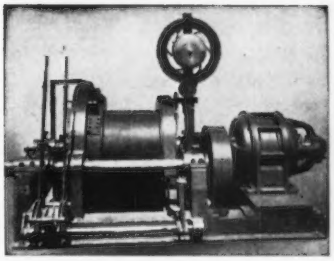

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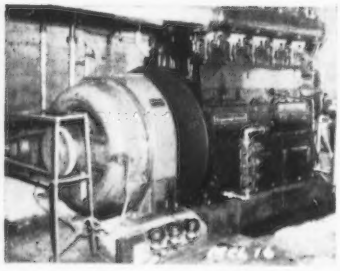
480 V. 3 ph, 60 cycle



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Engine: Ingersoll-Rand Type S, 273 BHP 720 rpm, air starting, 5 cyl, 1946 model.

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1—Goodman Mfg. Co. 95 AR 18 Belt Conveyor #2831, complete with Westgh. SK-DC Motor, 10 HP, 230 Volt, 1750 RPM, Frame 43, Sty. 1134227C, Serial #1-6G8886, Cleveland Worm Gear, Size 70 AT, Series 25, Link Belt Speed Reducer, Size W.B. 70 LH. Westgh. DC Controller Style 832859A.

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33—Spill Plates #34781
14—Standard Frames #34783
1—Drive Shaft #404680
89—Ball Bearing #261 RX for Forward Roller #140423

440 ft.—New 18", 4 x 6 Step Ply Conveyor Belting

1—Ingersoll-Rand Motor Pump, Type 2 RVP 7½, Serial #86911, 3300 RPM, with G.E. Co. Motor, 7½ HP, 230 V, Type B, Frame 254, Model 5B254A939, Serial #1687330.

3—Combination Line Starter and Disconnecting Switch, 25 HP, Class I, 3/60/440, Class 11-203 NU 2.

1—Goodman Mfg. Co. Conway Loader, Type 115, Serial #346, 36" Gauge, with Westgh. DC Motors.

5—Goodman Mfg. Co. E Shaker Conveyor, with Westgh. SK 63, 7½ HP, 1150 RPM, DC Motors, and Drive Troughs.

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12"	4	1/16"	1/32"	28 Oz.
14"	4	1/16"	1/32"	28 Oz.
16"	4	1/8"	1/32"	28 Oz.
18"	4	1/8"	1/32"	28 Oz.
20"	4	1/8"	1/32"	28 Oz.
20"	5	1/8"	1/32"	28 Oz.
24"	4	1/8"	1/32"	28 Oz.
24"	5	1/8"	1/32"	28 Oz.
26"	5	1/8"	1/32"	28 Oz.
30"	4	1/8"	1/16"	32 Oz.
30"	5	1/8"	1/16"	32 Oz.
30"	6	1/8"	1/16"	32 Oz.
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1—Merrill Crowe Precipitation Unit
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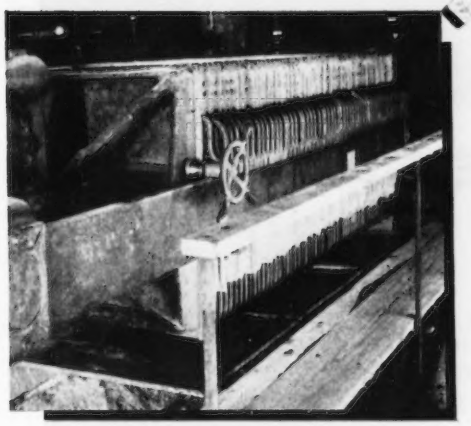

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40 WORTH ST. · NEW YORK

4-STAR PERFORMANCE AT MINNEWAS

Look where you will, you'll have a hard time matching the all-round performance of the Cat* D7 Tractor and No. 7A hydraulic Bulldozer that works for E. A. Young, Inc., at the Minnewas open-pit iron ore mine, Virginia, Minn. Here are some of the jobs this rugged, perfectly matched "team" does:

1. Strips from 40 to 60 ft. of overburden consisting of gravel, clay and rock.
2. 'Dozes spill around the shovel, as you see above.
3. Works hard on the dump.
4. Gives an assist to haul trucks.

Versatile Caterpillar-built Bulldozers and track-type Tractors can do many low-cost earthmoving jobs for you, too. Nothing else can equal their sturdy construction, well-engineered design and stay-on-the-job dependability. Exclusive 'dozer features include good balance and operator visibility and easy-to-make blade adjustments . . . plus a heavily reinforced, rigid blade that digs and *rolls* a full load every time. And Cat Diesel Tractors are world-famous for high drawbar horsepower, easy operation and minimum down time.

See your dealer for an on-the-job demonstration—*soon*.

Caterpillar Tractor Co., Peoria, Illinois.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

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Setting the Pace For TACONITE PROCESSING

World's Largest CRUSHER

THIS GIANT 60 x 109 gyratory crusher now being built in Allis-Chalmers shops will be capable of crushing 3500 tons of low grade iron ore an hour!

It is one of many contributions made since Allis-Chalmers first started the development of equipment for processing taconite ore . . . in the laboratory . . . in the pilot plant . . . and in actual operations on the iron range.

Other metallic ore producers, too, have looked to Allis-Chalmers, *world's most experienced manufacturer of processing equipment,* for crushers, grinding mills, screens and smelting machinery. Allis-Chalmers leadership assures you of equipment recommendations backed by *unsurpassed* experience in all phases of processing.

You'll find the A-C representative in your area a helpful consultant on your processing problems. Call him, or write Allis-Chalmers, Milwaukee 1, Wisconsin, for more facts.

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ALLIS-CHALMERS

Sales Offices in Principal Cities in the U. S. A. Distributors Throughout the World.

Hammermills

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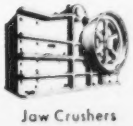


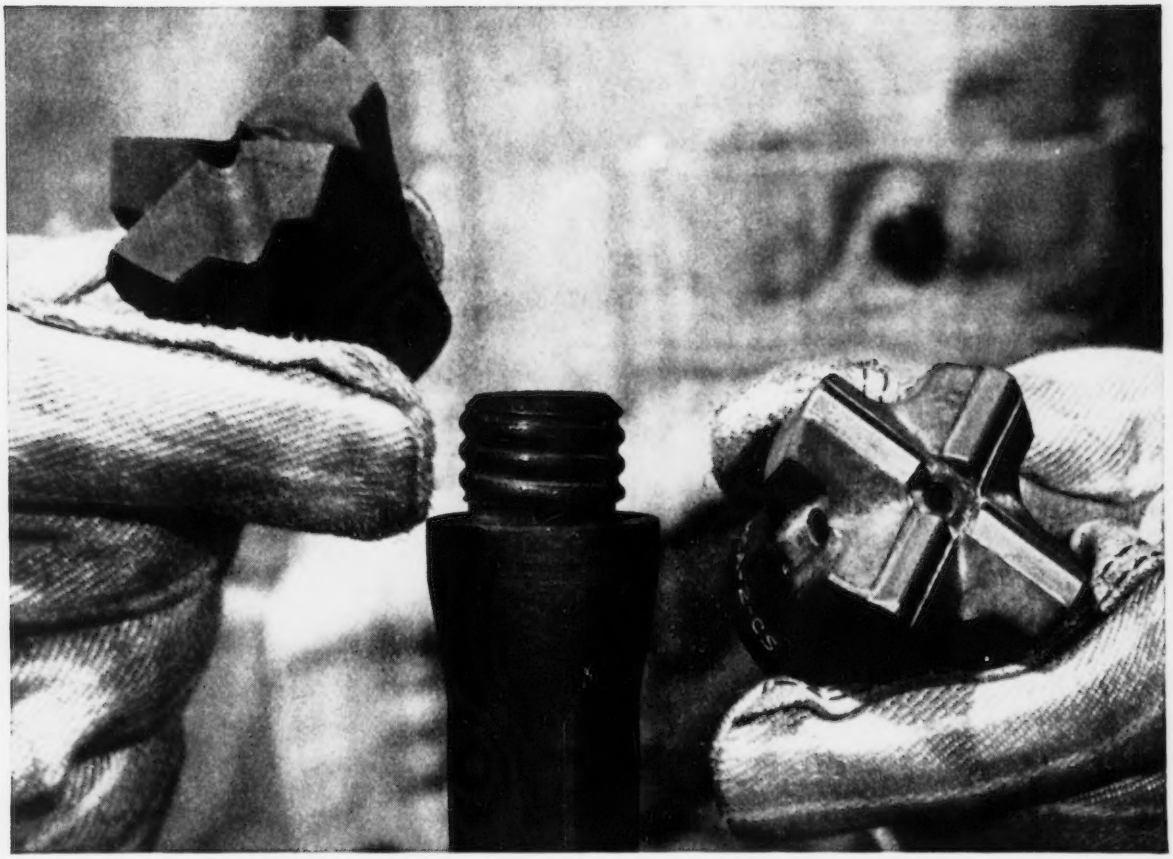
Jaw Crushers

Gyratory Crushers

Grinding Mills

Kilns, Coolers, Dryers

No costly delays to change steels with TIMKEN® interchangeable rock bits!



Dozens of different Timken® rock bits fit the same drill steel!

YOU get quick bit changes plus the right bit for the job when you use Timken® multi-use and carbide insert bits.

It takes just a minute to unscrew one type of Timken bit and screw another different bit on the same drill steel—right on the job! No time wasted going after another set of drill steels.

You get added drilling economy because the driller can switch to the most economical bit as the ground changes. And you eliminate the need for stocking a large inventory of different steels. Dozens of different Timken multi-use and carbide insert bits are interchangeable on the *same* drill steel.

Both Timken multi-use and carbide insert bits give you two important advantages: 1) made from electric furnace Timken alloy steel, 2) special shoulder union that keeps drilling impact from damaging threads.

Our rock bit engineers will be glad to help you with your drilling problems. They're experts in cutting drilling costs. There's no obligation. Write The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

WHERE YOU CUT COSTS WITH TIMKEN MULTI-USE BITS

Most economical for ordinary ground. With correct and controlled reconditioning, they give lowest costs per foot of hole when full increments of steel can be drilled.

WHERE YOU CUT COSTS WITH TIMKEN CARBIDE INSERT BITS

Give highest speed through hard, abrasive ground. Also most economical for constant-gage holes, small-diameter holes, very deep holes.

... your best bet for the best bit ... for every job

TIMKEN

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